REGISTER

OF

THE LEHIGH UNIVERSITY,

1886-1887.

TUITION FREE.

SOUTH BETHLEHEM, PA.:
1887.

REGISTER

OF

THE LEHIGH UNIVERSITY,

SOUTH BETHLEHEM, PA.

1886-1887.

FOUNDED BY ASA PACKER.

TUITION FREE.

BETHLEHEM, PA.
EDWIN G. KLOSÉ, MANAGER.
1887.

TABULAR ALMANAC.

1886.

JULY.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
...	...	...	...	...	...	...

AUGUST.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
...	...	...	...	...	...	...

SEPTEMBER.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	...	...
...	...	...	...	...	...	...

OCTOBER.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	..	...	...	...

NOVEMBER.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	...	...	...	...
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DECEMBER.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
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1887.

JANUARY.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
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23	24	25	26	27	28	29
30	31	...	...	...	...	...

FEBRUARY.

S	M	T	W	T	F	S
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6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	...	...	...	...	...
...	...	...	...	...	...	...

MARCH.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

APRIL.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
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MAY.

S	M	T	W	T	F	S
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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
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JUNE.

S	M	T	W	T	F	S
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	...	...
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JULY.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
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AUGUST.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
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14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	...	...	...
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SEPTEMBER.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	...
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OCTOBER.

S	M	T	W	T	F	S
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9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	...	...	...	...	...

NOVEMBER.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	...	...	...
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DECEMBER.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
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11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
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1888.

JANUARY.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
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FEBRUARY.

S	M	T	W	T	F	S
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	...	...	...
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MARCH.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
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APRIL.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	...	...	...	...	...
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MAY.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
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CALENDAR.

1886-1887.

1886. Sept. 13–15,	Monday, Tuesday and Wednesday,	Examinations for Admission.
Sept. 15,	Wednesday,	First Term begins.
Oct. 14,	Thursday,	Founder's Day.
Nov. 25,	Thursday,	Thanksgiving Day.
Dec. 22,	Wednesday,	First Term ends.
1887. Jan. 11, 12,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 12,	Wednesday,	Second Term begins.
Jan. 22,	Saturday,	Junior Prize Orations due.
Feb. 22,	Tuesday,	Washington's Birthday.
Feb. 23,	Wednesday,	Ash Wednesday.
April 7,	Thursday,	Easter Holidays begin.
April 12,	Tuesday,	Easter Holidays end at 8¼ A.M.
May 30,	Monday,	University-Day Orations due.
June 1,	Wednesday,	Theses of Seniors due.
June 1,	Wednesday,	Senior Examinations begin
June 8,	Wednesday,	Annual Examinations begin.
June 11,	Saturday,	Senior Examinations end.
June 15, 16, 17,	Wednesday, Thursday and Friday,	Examinations for Admission.
June 19,	Sunday,	Baccalaureate Sermon.
June 21,	Tuesday,	Class Day.
June 22,	Wednesday,	Alumni Day.
June 23,	Thursday,	University Day.

1887-1888.

1887. Sept. 12–14,	Monday, Tuesday and Wednesday,	Examinations for Admission.
Sept. 14,	Wednesday,	First Term begins.
Oct. 13,	Thursday,	Founder's Day.
Nov. 24,	Thursday,	Thanksgiving Day.
Dec. 21,	Wednesday,	First Term ends.
1888. Jan. 10–11,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 11,	Wednesday,	Second Term begins.
June 21.	Thursday,	University Day.

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Professor of Mining Engineering and Geology.

JOSEPH F. KLEIN, D.E.,
Professor of Mechanical Engineering.

LECTURER.

WILLIAM L. ESTES, M.D.,
Lecturer on Physiology and Hygiene.

INSTRUCTORS.

SPENCER V. RICE, C.E.,
Instructor in Drawing.

ARTHUR E. MEAKER, C.E.,
Instructor in Mathematics.

HARVEY S. HOUSKEEPER, B.A.,
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Instructor in Mathematics.

ENOS K. BACHMAN, E.M.,
Instructor in Metallurgy.

WILLIAM K. GILLETT, M.A.,
Instructor in Modern Languages.

WALTER MOELLER, PH.B.,
Instructor in Organic Chemistry.

FONGER DE HAAN, C.N.L.,
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LESTER P. BRECKENRIDGE, PH.B.,
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Instructor in Quantitative Analysis.

CHARLES N. LAKE, PH.C.,
Instructor in Qualitative Analysis and Assaying.

GEORGE F. DUCK, E.M.,
Instructor in Mining.

EDWIN F. MILLER, M.E.,
Instructor in Mechanical Engineering.

FAYETTE B. PETERSEN, C.E.,
Instructor in Metallurgy.

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Assistant,
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WILSON F. STAUFFER.

STUDENTS.

Clas.—Classical Course.
L.S.—Latin-Scientific Course.
Sci.—Course in Science and Letters.
Tech.—Technical Course.
A.C.—Analytical Chemistry.
C.E.—Civil Engineering.
E.M.—Mining Engineering.
M.E.—Mechanical Engineering.
Met.—Metallurgy.
Ad. Elec.—Advanced Electricity.

The students whose names are printed in *italics* are not clear of conditions.

GRADUATES.

	For Degree.	Residence.
George Rodney Booth, Ph.B.	M.E.,	Bethlehem.
Harry Augustus Butler, B.S.,	M.S.,	Mauch Chunk.
Robert Grier Cooke, B.A.,	M.A.,	Bethlehem.
Francis Joseph Crilly, B.A.,	M.A.,	Philadelphia.
William Henry Dean, A.C., M.S.,	E.M.,	Clarence, Iowa.
William Theodore Goodnow, C.E.,	M.S.,	South Bethlehem.
Simeon Cole Hazelton, B.M.,	E.M.,	Washington, D.C.
John Daniel Hoffman, B.A.,	M.A.,	Bethlehem.
Preston Albert Lambert, B.A.,	M.A.,	Bethlehem.
Elmer Henry Lawall, C.E.,	M.S.,	Audenried.
William Anthony Lydon, B.M.,	E.M.,	Chicago, Ill.,
Wilson Franklin More, B.A.,	M.A.,	Lancaster.
George Spencer Patterson, E.M.,	M.S.,	Mahanoy City.
George Arthur Ruddle, Ph.B.,	M.A.	E. Mauch Chunk.
William Heysham Sayre, jr., M.E.,	C.E.,	South Bethlehem.

	Course.	Residence.
Lewis Buckley Semple, B.A.,	M.A.,	Reading.
Edwin Stanton Stackhouse, B.M.,	E.M.,	Shickshinny.
Theodore Stevens, B.M.,	E.M.,	New York, N.Y.
William Patterson Taylor, B.A.,	M.A.,	Philadelphia.
Priestley Toulmin, B.M.,	E.M.,	Bethlehem.
Leonard Blakslee Treharn, B.A.,	M.A.,	Boston, Mass.
James Hollis Wells, C.E.,	M.S.,	New York, N.Y.

SENIOR CLASS.

	Course.	Residence.
Frank Fielding Amsden,	E.M.,	Scranton.
Robert Webb Barrell,	E.M.,	New Providence, N.J.
Alexander Bonnot,	C.E.,	Norfolk, Va.
Richard Singmaster Breinig,	E.M.,	Breinigsville.
Charles Austin Buck,	A.C.,	South Bethlehem.
Julian Carter Buckner,	M.E.,	Baltimore, Md.
Benjamin Amos Cunningham,	C.E.,	Frederick City, Md.
Eugene Diven,	M.E.,	Elmira, N.Y.
Alfred Doolittle,	Clas.,	Bethlehem.
Francis Rouad Dravo,	M.E.,	Allegheny.
Milton Henry Fehnel,	Sci.,	Bethlehem.
Harvey Sheafe Fisher,	Clas.,	Pottsville.
Kenneth Frazier,	Clas.,	Bethlehem.
Henry Stevens Haines, jr.,	M.E.,	Savannah, Ga.
John Benjamin Franklin Hittell,	C.E.,	Allentown.
John Myers Howard,	M.E.,	Hagerstown, Md.
Charles Colcock Jones,	E.M.,	New Orleans, La.
William Frederick Kiesel, jr.,	M.E.,	Scranton.
James Wesson Kittrell,	C.E.,	Winona, Miss.
John Walter LaDoo,	C.E.,	Houghton, Mich.

	Course.	Residence.
Samuel Davis Langdon,	M.E.,	Augusta, Ga.
Garrett Brodhead Linderman, jr.,	Sci.,	South Bethlehem.
Harry Smuller Meily,	C.E.,	Middletown.
James Alexander Morrow,	C.E.,	Tyrone.
Henry Benjamin Charles Nitze,	E.M.,	Baltimore, Md.
George Francis Pettinos,	M.E.,	Carlisle.
Robert Henry Phillips,	C.E.,	Washington, D.C.
William Ross Pierce,	E.M.,	Franklin Furnace, N. J.
Francis William Birchal Pile,	E.M.,	London, England.
Rufus King Polk,	E.M.,	Columbia, Tenn.
Charles Pope Pollak,	C.E.,	St. Louis, Mo.
Mason Delano Pratt,	C.E.,	Carlisle.
Evan Turner Reisler,	C.E.,	Calvert, Md.
George Thomas Richards,	C.E.,	Pittsburgh.
John Warwick Scull,	M.E.,	Philadelphia.
Frank Stuart Smith,	A.C.,	Wyoming.
Elmer Ellis Snyder,	C.E.,	Bethlehem.
Edward Eckert Stetson,	A.C.,	Reading.
Harry Harkness Stoek,	E.M.,	Washington, D.C.
Harry Eugene Stout,	E.M.,	Audenried.
Otway Owen Terrell,	M.E.,	Burton's Creek, Va.
Edward Power Van Kirk,	E.M.,	Elizabeth.
August Julius Wiechardt,	M.E.,	Philadelphia.
Henry August Julius Wilkens,	E.M.,	Baltimore, Md.
Frank Williams,	E.M.,	Johnstown.
Nissley Joseph Witmer,	C.E.,	Lebanon.
Wade Hampton Woods,	Sci.,	Philadelphia.
George Frederic Yost,	M.E.,	Bethlehem.
Charles Frederic Zimmele,	L.S.,	Bethlehem.

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	Course.	Residence.
Charles Lambert Addison,	M.E.,	Reading.
George Reade Baldwin,	M.E.,	Elmira, N.Y.
Charles Lincoln Banks,	Sci.,	Bridgeport, Conn.
Edmund A. Bates,	C.E.,	Charlestown, W.Va.
Frederic Sturtevant Bates,	M.E.,	Titusville.
William Donaldson Beatty,	C.E.,	Pottsville.
Francisco Alberto Bermudes,	C.E.,	Leon, Nicaragua.
Hubert Alexander Bonzano,	C.E.,	Phœnixville.
William Bradford,	C.E.,	Dover, Del.
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Otto Cornelius Burkhardt,	E.M.,	Bethlehem.
Charles Noble Butler,	C.E.,	Loag.
Morton Lewis Byers,	C.E.,	Pittsburgh.
John Jesse Clark,	M.E.,	Corning, N. Y.
Charles Philip Coleman,	M.E.,	Baltimore, Md.
George Philip Connard,	C.E.,	Reading.
Justice Cox Cornelius,	C.E.,	Philadelphia.
Augustus Crawford, jr.,	E.M.,	Baltimore, Md.
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George Herschel Davis,	C.E.,	Cavendish, Vt.
William Schaff Davis,	C.E.,	Reading.
Philip Hoffecker DeWitt,	C.E.,	Weatherly.
Manuel Victor Domenech,	C.E.,	Isabela, Porto Rico.
George Patterson Dravo,	M.E.,	Allegheny.
Charles Wesley Focht,	C.E.,	Pottsville.

	Course.	Residence.
George Steinman Franklin,	M.E.,	Lancaster.
Samuel Wilson Frescoln,	C.E.,	Reading.
Louis Prevost Gaston,	E.M.,	Somerville, N. J.
William Gates, jr.,	C.E.,	Kittanning.
James Bolan Glover,	M.E.,	Marietta, Ga.
Hughlett Hardcastle,	M.E.,	Easton, Md.
George Augustus Hart,	M.E.,	South Bethlehem.
John Howard Hartman,	M.E.,	Lancaster.
Robert Browne Honeyman,	E.M.,	Bethlehem.
Sterry Henry Jencks,	C.E.,	Providence, R. I.
Frederick Hayes Knorr,	A.C.,	Philadelphia.
Ralph William Lee,	C.E.,	Washington, D.C.
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Howard Leoser McIlvain,	A.C.,	Reading.
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George Philips Miller,	C.E.,	Lewisburg.
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Harry Palmer,	C.E.,	Wilmington, Del.
Charles Jeremiah Parker,	C.E.,	Watertown, N. Y.
Robert Swain Perry,	A.C.,	Philadelphia.
Albert George Rau,	Sci.,	Bethlehem.
Clarence Elmer Raynor,	C.E.,	Manorville, N. Y.

	Course.	Residence.
William Pemberton Richards,	C.E.,	Milford, Del.
Osmond Rickert,	C.E.,	Black Ridge.
William Richard Sattler,	M.E.,	Baltimore, Md.
George Brinkerhoff Shane,	C.E.,	Washington, D.C.
Eugene Hicks Shipman,	C.E.,	Clinton, N. J.
William Alonzo Stevenson,	M.E.,	Clark's Green.
Wyndham Harvey Stokes,	E.M.,	Gordonsville, Va.
Wilmer Marshall Webb,	M.E.,	Lancaster.
Harvey Musser Wetzel,	C.E.,	Bellefonte.
Charles McCombs Wilkins,	L.S.,	Warren, Ohio.
Winter Lincoln Wilson,	C.E.,	Elkton, Md.
Edward Benjamin Wiseman,	C.E.,	Elmira, N. Y.
Walter Wykoff,	E.M.,	Belvidere, N. J.
Luther Reese Zollinger,	C.E.,	Harrisburg.

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	Course.	Residence.
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Pearce Atkinson,	M.E.,	Chicago, Ill.
Gustav Ayres,	M.E.,	Washington, D.C.
Ralph Putnam Barnard,	C.E.,	Washington, D.C.
Samuel Erwin Berger,	Clas.,	Richland Centre.
Charles Hudson Boynton,	L.S.,	Washington, D.C.
Joseph Leander Budd,	A.C.,	Mount Holly, N.J.
William Butterworth,	M.E.,	Cincinnati, Ohio.
Edgar Campbell,	Clas.,	South Bethlehem.
Francis Duncan Campbell,	C.E.,	Kansas City, Mo.
Francis Joseph Carman,	A.C.,	Washington, D.C.
Herbert Mackenzie Carson,	M.E.,	Baltimore, Md.

	Course.	Residence.
Leonardo Bravo y Castro,	E.M.,	Santiago de Cuba.
Lansford Foster Chapman,	C.E.,	Catasauqua.
Holden William Chester,	C.E.,	Shamokin.
Charles William Corbin,	E.M.,	Telluride, Col.
William Albert Cornelius,	M.E.,	Philadelphia.
Charles Herbert Deans,	C.E.,	Phœnixville.
Emil Diebitsch,	C.E.,	Washington, D.C.
Charles Estell Dickerson, jr.,	Sci.,	New Germantown, N. J.
John Webster Dougherty,	E.M.,	Steelton.
Ralph Marshall Dravo,	E.M.,	Allegheny.
Albert Edward Duckham,	C.E.,	Pittsburgh.
Ernest Hipolite Du Vivier,	A.C.,	New York City.
William Dolloway Farwell,	Clas.,	Oswego, N. Y.
Charles Langly Flack.	E.M.,	Washington, D.C.
Jacques DuGué Ferguson,	C.E.,	Greenville, Miss.
John Douglas Forster,	C.E.,	Harrisburg.
Arthur Hugh Frazier,	Clas.,	Bethlehem.
Frederick Louis Grammer,	E.M.,	Baltimore, Md.
George Wentz Harris,	E.M.,	Silver Brook.
Robert Anderson Heberling,	L.S.,	Mauch Chunk.
Lightner Henderson,	C.E.,	Gap.
Conrad Egbert Hesse,	E.M.,	Washington, D.C.
Adolph Hoehling,	C.E.,	Washington, D.C.
Wallis Eastburn Howe,	Clas.,	Reading.
Clarence Walter Hudson,	C.E.,	Manasquan, N. J.
Emilio Hurtado,	C.E.,	Rivas, Nicaragua.
Arch Johnston,	M.E.,	Bethlehem.
Robert Joseph Jones	C.E.,	Lansford.
John Stower Kellogg, jr.,	A.C.,	Atchison, Kan.
John Martin Sharpless Kerlin,	M.E.,	Elwyn.
Sylvanus Elmer Lambert,	Clas.,	Seidersville.

	Course.	Residence.
George Crist Landis,	E.M.,	Middletown.
John Lockett,	M.E.,	Glengoffe, Jam.
Thomas Smith Leoser,	E.M.,	New York City.
John Joseph Lincoln,	C.E.,	Farmington, Md.
Arthur Long,	E.M.,	Wilkes-Barre.
George Eber Manning,	C.E.,	Lebanon, Conn.
William Clark McLeod,	M.E.,	Rugby, England.
Charles Henry Miller,	A.C.,	Norristown.
Charles Williams Moffett,	M.E.,	Athens, Greece.
Richard Henry Morris, jr.,	E.M.,	Bristol.
William Ellis Morris,	A.C.,	Portland, Ore.
John Thomas Morrow,	M.E.,	Washington, D.C.
Thomas Franklin Newby,	C.E.,	Harrisburg.
Albert Daniel Oberly,	C.E.,	Easton.
Joseph Michael O'Malley,	A.C.,	Wilkes-Barre.
William Bliem Ott,	C.E.,	Doylestown.
Albert Nickerson Palmer,	E.M.,	Baltimore, Md.
Clarence Reynolds Phillips,	C.E.,	Harrisburg.
Robert Henry Eddy Porter,	M.E.,	Morristown, N. J.
Frank R. Reynolds,	A.C.,	Marietta, Ga.
Arnold Karthaus Reese,	E.M.,	Baltimore, Md.
John Brown Robertson, jr.,	E.M.,	AmherstC.H., Va.
Abraham Lincoln Rogers,	M.E.,	Fort Wayne, Ind.
Louis Augustus Round,	M.E.,	Providence, R. I.
Horace Hendel Sayre,	C.E.,	Philadelphia.
Charles William Schwartz, jr.,	M.E.,	Germantown.
Arthur Moult Smyth,	E.M.,	Philadelphia.
James Stewart, jr.,	C.E.,	Lancaster.
Alfred Walton Stockett,	C.E.,	Mauch Chunk.
Lester Clark Taylor,	C.E.,	Pawtucket, R. I.
Augustus Thompson Throop,	C.E.,	Port Gibson, N.Y.

	Course.	Residence.
Charles Prentice Turner,	M.E.,	Oxford, N. Y.
Clarence Walker,	E.M.,	Pottsville.
Philip Sidney Webb,	M.E.,	Bethlehem.
Harry Rush Woodall,	E.M.,	Philadelphia.
Walter Earle Weimer,	A.C.,	Lebanon.
Edward Austin Wright,	C.E.,	Northampton, Mass.
Joseph Bodine Wright,	C.E.,	South Easton.

FRESHMAN CLASS.

	Course.	Residence.
Edward Walter Abell,	C.E.,	N. Franklin, Conn
Howard Emory Alcott,	C.E.,	Mt. Holly, N. J.
George Kerr Anderson,	L.S.,	Franklin.
Herbert Ennis Arnold,	M.E.,	Aurora, Ill.
Thos. Chalkley James Baily, jr.,	C.E.,	Newark, N. J.
George Barclay,	A.C.,	Bethlehem.
Frederick Richard Barrett,	C.E.,	El Paso, Tex.
Albert Harlan Bates,	M.E.,	Cleveland, O.
Edwin Herbert Beazell,	C.E.,	Chillicothe, Mo.
Wesley Hudson Beck,	C.E.,	Utica, N. Y.
Herman Stadiger Borhek,	Sci.,	Bethlehem.
Charles Marcus Breder,	E.M.,	Bethlehem.
James W. Boyd,	C.E.,	Seek.
Jacob Burr Buckley,	M.E.,	Oxford, N. Y.
Adolph Cardenas,	C.E.,	Nicaragua.
John Merriken Carter, jr.,	C.E.,	Baltimore, Md.
Charles Baldwin Cassady,	C.E.,	Baltimore, Md.
David Castleman,	C.E.,	Louisville, Ky.
Morgan Chace,	L.S.,	Elizabeth, N. J.

	Course.	Residence.
Frank Riley Chapman,	C.E.,	Steubenville, O.
Holden Thomas Chester,	M.E.,	Williamstown.
Franklin Clarke, Jr.,	M.E.,	Vincennes, Ind.
William Phelps Cleveland,	A.C.,	Waterville, N. Y.
John Charles Connolly,	M.E.,	South Bethlehem.
James Mosgrove Colwell,	A.C.,	Kittanning.
Warren Scott Cope,	C.E.,	Philadelphia.
Charles Ellery Coxe,	E.M.,	Reading.
James Barlow Cullum,	A.C.,	Meadville.
John Rose Davis,	C.E.,	Phœnixville.
Clement Heyser Detwiler,	C.E.,	Ironbridge.
Eric Doolittle,	C.E.,	Bethlehem.
John Blandon Douty,	C.E.,	Shamokin.
Daniel Edward Downey,	E.M.,	South Bethlehem.
Harry Oliver Duerr,	E.M.,	Cleveland, O.
Cornelius Dugan,	A.C.,	South Bethlehem.
Lester Nallet Ely,	E.M.,	New York City.
Delevan Emery,	A.C.,	Bradford.
Walter Lowe Fairchild,	C.E.,	Hammondsport, N.Y.
Walter Famariss,	C.E.,	Beverly, N. J.
Francis Hughes Farquhar,	L.S.,	Pottsville.
Charles Edward Fink,	C.E.,	Harrisburg.
Frederick Elmer Fischer,	C.E.,	New York City.
Frank Roberts Fisher,	C.E.,	Philadelphia.
James William Flack, jr.	C.E.,	Baltimore, Md.
John George Fleck,	C.E.,	Philadelphia.
Howard Augustus Foering,	Sci.,	Locust Valley.
Robert David Frey,	L.S.,	Centre Valley.
Eugene Uz Gibbs,	M.E.,	Mt. Holly, N. J.
Ralph Goodman,	C.E.,	Atglen.
George Ellsworth Greene,	C.E.,	Rochester, N. Y.

	Course.	Residence.
Harry Walter Harley,	M.E.,	Gloucester, N. J.
David Garth Hearne,	C.E.,	Wheeling, W. Va.
Julian Green Hearne,	C.E.,	Wheeling, W. Va.
Harry Boyd Hess,	C.E.,	Bloomsburg.
James Stevens Bush Hollinshead,	E.M.,	Dayton, O.
Paul Depue Honeyman,	L.S.,	Bethlehem.
John Turner Hoover,	C.E.,	Philipsburg.
Edward Rogers Hopkins,	M.E.,	Port Deposit, Md.
Frederic Kidder Houston,	M.E.,	New York City.
Alexander Chambers Howard,	M.E.,	Pittsburgh.
Christopher Gadsden Howe,	C.E.,	Charleston, S. C.
William Jennings,	C.E.,	Harrisburg.
Charles Radcliffe Johnson,	C.E.,	Wilmington, Del.
Amos Dey Kennedy,	M.E.,	Philadelphia.
Harry Hiram King,	M.E.,	Bethlehem.
Henry Meyers Kurtz,	M.E.,	Allentown.
Harry Kinzer Landis,	E.M.,	Landis Valley.
John Le Droit Langdon,	E.M.,	Buffalo, N. Y.
John Elmer Litch,	M.E.,	Steelton.
Francisco Jil Manrique,	E.M.,	Bogota, S. A.
Simon Strock Martin,	E.M.,	Steelton.
Joaquin Martinez,	C.E.,	Nicaragua.
Allan Moore Masser,	M.E.,	Scranton.
William David Matheson,	A.C.,	Brooklyn, N. Y.
Henry Stewart McKee,	E.M.,	Washington, D.C.
Victoriano Mendozo,	C.E.,	Gaudalajara, Mex.
Robert Sayre Mercur,	C.E.,	Wilkes-Barre.
George Franklin Metzger,	Clas.,	Bethlehem.
Charles Herbert Miller,	A.C.,	Huntingdon.
Robert Douglas Millholland,	A.C.,	Reading.
George Smuller Mish,	C.E.,	Middletown.

	Course.	Residence.
Daniel McFarlan Moore,	M.E.,	Bethlehem.
Orson Henry Moser,	C.E.,	Butztown.
George Nauman, jr.,	C.E.,	Lancaster.
Robert Engler Neumeyer,	C.E.,	Bethlehem.
Charles Wesley Palmer,	C.E.,	Tuckerton, N. J.
William Cassidy Perkins,	C.E.,	Williamsport.
Henry Fred Pflueger,	C.E..,	Seidersville.
Asa Emory Phillips,	C.E.,	Washington, D.C.
Charles Wiltberger Platt,	C.E.,	New York City.
Edward Williams Pratt,	L.S.,	Ft. Atkinson, Wis.
Edwin Jay Prindle,	M.E.,	Washington, D.C.
John Stover Riegel,	M.E.,	Riegelsville, N. J.
Frank Weyman Ritchey,	C.E.,	Pittsburgh.
Joseph Edgar Sanborn,	A.C.,	Bellows Falls, Vt.
Ellis Anstett Schnabel,	Clas.,	Bethlehem.
Harry Johns Sherman,	C.E.,	Mount Holly, N.J.
Stewart Applegate Shimer,	M.E.,	Bethlehem.
Harry Maxwell Shoemaker,	M.E.,	Reading.
William Calvin Shoemaker,	C.E.,	Reading.
Raymond Walton Smith,	A.C.,	Trenton, N. J.
William Buchecker Spengler,	M.E.,	Bethlehem.
William Augustus Stedman, jr.,	E.M.,	Newport, R. I.
Charles Hugh Stevenson,	C.E.,	Snow Hill, Md.
William Alston Stevenson,	M.E.,	Lewistown.
Joseph William Stone,	M.E.,	New Orleans, La.
R. Paul Stout,	M.E.,	Audenried.
Mercer Brown Tate,	M.E.,	Harrisburg.
Francis Dupont Thomson,	M.E.,	Philadelphia.
Charles Cookman Tomkinson,	M.E.,	Galena, Md.
Claud Atten Porter Turner,	C.E.,	Lime Rock, R. I.
George Hippard Tyler,	C.E.,	Napoleon, Ohio.

	Course.	Residence.
Aaron Howell Van Cleve,	Sci.,	Easton.
Henry Wadleigh,	A.C.,	South Bethlehem.
Theodore Vetterlein Warne,	Sci.,	Philadelphia.
William Adler Webb,	M.E.,	Bethlehem.
Clarence Shindel Weldy,	A.C.,	Tamaqua.
George Edward Wendle,	M.E.,	Philadelphia.
Frank Shriver West,	C.E.,	Philadelphia.
David Thomas Williams,	M.E.,	Catasauqua.
Herbert Wright,	M.E.,	Northampton, Mass.

STUDENTS IN ADVANCED ELECTRICITY.

	Residence.
John Clark Finney,	Milwaukee, Wis.
Walter George Fuller,	Brattleboro, Vt.
William Shankland Gorman,	Philadelphia.
John Wesley Hackney,	Smith's Landing, N.J.
William Sigler Jones,	Germantown.
Burton Mansfield Marks,	Philadelphia.
Dion M. Martinez, jr.,	Philadelphia.
Horace Fields Parshall,	Milford, N. Y.
Arthur Dayton Spear,	Garfield, Ohio.
Eduardo Perez Triana,	Bogota, S. A.
John Brinton Whitehead,	Pittsburgh.
George Henry Wolle,	Bethlehem.

SPECIAL STUDENTS.

	Course.	Residence.
Henry M. Byllesby,	M.E.,	New York City.
Charles Belmont Davis,	A.C.,	Philadelphia.
George Herman Koehler,	M.E.,	Hunter'sPt., N.Y.
Harry Clayton Landon,	C.E.,	Frenchtown, N.J.
Alfred Kramer Leuckel,	L.S.,	Lehighton.
Geo. Kemmerer Musselman, B.A.,	C.E.,	New Mahoning.
Lewis Clyde Smith,	A.C.,	Muncy.
Augustus Courtland Spotts,	C.E.,	Tazewell C. H., Va.
Rogers Clarke Ballard Thruston, Ph.B.,	E.M.,	Louisville, Ky.
Homer David Williams,	A.C.,	Johnstown.

SUMMARY OF STUDENTS BY CLASSES.

Graduates,	22
Seniors,	49
Juniors,	70
Sophomores,	81
Freshmen,	121
Students in Advanced Electricity,	12
Specials,	10
Total,	365

SUMMARY OF STUDENTS BY STATES.

Vermont,	5
Massachusetts,	3
Connecticut,	3
Rhode Island,	5
New York,	28
Pennsylvania,	198
New Jersey,	20
Delaware,	4
Maryland,	22
District of Columbia,	18
Virginia,	5
West Virginia,	4
South Carolina,	1
Georgia,	4
Mississippi,	2
Louisiana,	2
Ohio,	8
Indiana,	2
Illinois,	3
Michigan,	1
Wisconsin,	2
Iowa,	1
Missouri,	3
Kentucky,	2
Tennessee,	1
Kansas,	1
Colorado,	1
Oregon,	1
Texas,	1
Mexico,	1

Nicaragua,	4
Porto Rico,	1
Cuba,	1
Jamaica,	1
England,	2
Greece,	1
United States of Columbia,	2
Total,	365

SUMMARY OF STUDENTS BY COURSES.

SCHOOL OF GENERAL LITERATURE.

Classical Course,	20	
Latin-Scientific Course,	12	
Course in Science and Letters,	15	
		47

SCHOOL OF TECHNOLOGY.

Course in Civil Engineering,	136	
Course in Mining Engineering,	58	
Course in Mechanical Engineering,	79	
Course in Analytical Chemistry,	33	
Course in Electrical Engineering,	12	
		318
Total,		365

THE LEHIGH UNIVERSITY.

ORIGIN.

The Hon. ASA PACKER, of Mauch Chunk, during the year 1865, appropriated the sum of Five Hundred Thousand Dollars, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational Institution in the rich and beautiful Valley of the Lehigh. From this Foundation rose THE LEHIGH UNIVERSITY, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his life-time, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete technical education for those professions which had developed the peculiar resources of the surrounding region. Instruction was to be liberally provided in Civil, Mechanical and Mining Engineering, Chemistry, Metallurgy, and in all needful collateral studies. French and German were made important elements in the collegiate course. A School of General Literature was part of the original plan, together with tuition in the ancient Classics.

FREE TUITION.

All these educational facilities are provided without charge. Through the generosity of the Founder, the Trustees were enabled, in 1871, to declare tuition FREE in all

branches and classes. The Lehigh University is open to young men of good character and suitable preparation from every part of our own land and of the world. To this fact the attention of the pupils of our public schools and of the graduates of classical institutions is especially called. Thus is offered, *without charge*, every facility for studying the professions of the Civil, Mechanical and Mining Engineer, and of the Metallurgist and Analytical Chemist. In the Classical and Scientific departments of the School of General Literature instruction is given in the Classics, Sciences and Letters.

PUBLIC WORSHIP.

Prayers are held in the Chapel every morning and all students are required to be present.

Divine Service is held on every Sunday morning in the Chapel of the University. The service is according to the forms of the Protestant Episcopal Church, under whose auspices the University was placed by its Founder. Attendance is required of every student, except in case of those connected with other religious bodies, to whom the President will grant permission at the beginning of each term (if requested by the parent or guardian, or by the student himself if he be 21 years of age) to attend during that term the place of worship of the body with which he is connected, where attendance on Sunday morning will be required.

SITE.

The situation of the Institution is healthful and beautiful. The region is famous for its railway and manufacturing enterprises; it possesses some of the richest iron and coal mines in our land, and thus gives the students rare facilities for confirming the teachings of the recitation room by the observation of the eye.

The University Buildings are about a half-mile from the depot, at the junction of the Lehigh Valley and North Pennsylvania Railroads. New York is ninety-two, and Philadelphia fifty-four miles distant.

BUILDINGS.

PACKER HALL,

named after the Founder, stands seven hundred feet back of Packer Avenue, at the base of the South Mountain. It is built of stone, and contains the Chapel, Lecture and Recitation Rooms, the Drawing Rooms and the Cabinets.

THE CHEMICAL LABORATORY.

is thoroughly fire-proof, is built of sandstone, and is 219 feet in length by 44 in width.

There are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories, the former accommodating 48 and the latter 84 students. These rooms are 20 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum and laboratories for organic, physiological, agricultural and sanitary Chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air-pump for vacuum filtration, a store room and the toilet.

A photographic laboratory is located in the third story of the central portion of the building.

THE METALLURGICAL LABORATORY,

contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals, a museum for mineralogical and metallurgical collections, a mineralogical laboratory provided with a Fuess reflecting goniometer, a polariscope, a Groth's "universal apparat" and a Rosenbusch polarizing microscope, a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast,

and a wet laboratory for ordinary analytical work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students to familiarize themselves with the methods of measurement and research employed in mineralogy and metallurgy, and to conduct original investigations in these departments of science.

THE NEW PHYSICAL LABORATORY,

consists of three stories. A large lecture room with a seating capacity of 150, occupies a portion of the second and third floors. It is well lighted and admirably adapted to its purposes. On the remainder of these floors are two rooms, each 40 feet long, for Heat and Light laboratories, a dark room for photographic work, spectroscopic and apparatus rooms and the private laboratories of the instructors.

The lower floor is devoted to the use of the students in the Advanced Electrical Course. A large room nearly 40 feet square is used as the Electrical Laboratory. There are smaller rooms for photometric and spectroscopic work, also reading, balance, apparatus and engine rooms. On the floor a 12 horse-power high speed engine and a dynamo supply two systems of electric lights, one of 25 incandescent lamps, the other of four arc lights, for practical tests in the Electrical Laboratory and for experimental purposes in the lecture room above. In the cellar are battery, store rooms, etc.

THE SAYRE OBSERVATORY.

Near Brodhead Avenue is the Sayre Observatory, the gift of Robert H. Sayre, Esq., of South Bethlehem, containing an equatorial and a zenith telescope, transit instrument and astronomical clock.

THE UNIVERSITY LIBRARY.

To the east of Packer Hall is the University Library, erected by the Founder in memory of Mrs. Lucy Packer Linderman, his daughter.

THE GYMNASIUM

is a handsome and spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus, besides Dr. Sargent's system of Developing Appliances. It is provided with hot and cold water; tub, sponge and shower baths, and 306 clothes closets. Opportunities for recreation and amusement are provided in the billiard room and bowling alleys. It is under the immediate care of a skilled and competent Director.

All students are required to undergo a physical examination before being allowed the use of the Gymnasium, and this examination will be repeated once each year during their stay at the University. The proper exercise is prescribed and is required of every student. The aim of the Institution is to promote a harmonious symmetrical development best suited to the individual condition of the student.

EXPENSES.

Tuition is FREE in all branches and classes. Books, materials, paper, pencils, chemical materials used in the analytical laboratory and drawing instruments, are furnished by the student.

Rooms and Board can not be had in University buildings, but can readily be obtained in many private houses.

The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included:

Board for 40 weeks, . . .	from $160	to $200
Room-rent, with fuel and lights .	40 "	80
Care of room and use of furniture,	5 "	20
Washing and incidentals, . . .	20 "	40
Books, stationery, etc., . . .	25 "	50
Total, ...	$250	to $390

NOTE.—If clubs be formed the cost of board need not exceed $3.50 per week.

ADMISSION OF STUDENTS.

ENTRANCE EXAMINATIONS.

Application for admission should be made to the President of the University, from whom all information may be obtained.

DATE OF EXAMINATIONS.

Examinations for admission to the University are held at the opening of each term, and also in June at the close of the Academic year.

The examinations for 1887 will be on Tuesday and Wednesday, January 11 and 12, for admission to the *second term*; on Wednesday, Thursday and Friday, June 15, 16 and 17, and on Monday, Tuesday and Wednesday, September 12, 13 and 14, for admission to the first term. No other examinations for entrance will be held, except for good cause, and all applicants *must* be in attendance at 8.30 on the morning of the first day.

The examinations are held in the following order:

First Day.—English Grammar, 9.00 A.M.; Geography, 11.30 A.M.; United States History, 2 P.M.; Physical Geography, 4 P.M.

Second Day.—Geometry, 9 A.M.; Arithmetic, 2 P.M.; Algebra, 3.30 P.M.

Third Day.—Latin and Roman History; Elementary Physics, 8.30 A.M.; Greek and Greek History; Advanced Course in Electricity, 2 P.M.

CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in *writing*, supplemented by an oral examination at the option of the examiner.

All candidates for admission must be at least sixteen years of age, must present testimonials of good moral character, and, *must satisfactorily pass in the following subjects:*

1. *English Grammar*, including composition, spelling and punctuation. It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution.*

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion. and Progressions.

[Olney's University Algebra is recommended, as it is the text-book used in the University.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilinear Figures. Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures. The Plane and Polyhedral Angles.

[Chauvenet's Geometry, (six books) is recommended, as it is the text-book used in the University.]

For admission to the various courses, (except that in Advanced Electricity,) *in addition* to the requirements above given, the examinations are as follows :

For the Course in Science and Letters, Civil, Mechanical and Mining Engineering, and Analytical Chemistry.

7. *Elementary Physics.*

[Avery or Gage is recommended.]

For the Latin-Scientific and Classical Courses.

8. *Physical Geography.*

9. *Latin Grammar*, (Harkness' preferred).

10. *Cæsar*, four books of the Gallic war.

11. *Cicero*, six orations, including the four against Cataline.

12. *Virgil*, the Bucolics and the first six books of the Aeneid, including Prosody.

13. The translation, at sight, of passages from Cæsar and Cicero.

14. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making Latin, both oral and written, with all the studies of the preparatory course.)

15. *Roman History.* Creighton's Primer of Roman History is suggested as indicating the amount required.

For the Classical Course only.

16. *Greek Grammar*, (Goodwin's preferred).

17. *Xenophon*, Anabasis, four books.

18. *Homer*, Iliad, three books, including Prosody.

19. The translation, at sight, of a passage from some work of Xenophon.

20. *Greek History.* Fyffe's Primer of Greek History is suggested.

21. Writing Greek with accents.

The pronunciation of Greek according to the written accents is followed in the University, and it is desirable that students preparing to enter be taught this system.

For the Advanced Course in Electricity,

however, the requirements are only the following :

1. Theoretical knowledge of the General Principles of Chemistry.

2. Arithmetic, Algebra through Radicals and Equations of the Second Degree, Plane Geometry, Mensuration and Plane Trigonometry.

Only practical familiarity with the rules and formulæ of these branches is required.

3. A course in Elementary Mechanics, Sound, Light and Heat, such as is given in Ganot, Deschanel or Olmstead.

Division of Entrance Examinations.

Candidates for admission to the Freshman Class may pass all the examinations *at once* or may take them in *two consecutive years*. In the latter case for the Technical courses and the course in Science and Letters, candidates may present themselves for examination in the first year in the following subjects: English Grammar, Geography, History of the United States, and Arithmetic. No credit will be given unless the candidate has passed satisfactorily in at least three subjects at one examination.

The examinations in Algebra, Geometry and Physics must be passed in June or September of that year in which the candidate proposes to enter the University.

In the Latin-Scientific and Classical courses candidates may present themselves for examination in the first year in the following subjects: English Grammar, History of the United States, Arithmetic, Physical Geography, and Roman History. No credit will be given unless the candidate has passed at least four of the subjects at one examination.

The examination in Latin may also be divided, but no credit will be given unless the candidate has passed in at least three of the topics specified at one examination. The examination in the remaining subjects must be passed in June or September of that year in which the candidate proposes to enter the University.

Candidates intending to enter the University in September are advised to present themselves for examination in June; credit will be given for any examinations satisfactorily passed at that time.

CONDITIONAL ADMISSION.

A candidate failing to pass in one or more of the subjects required for admission may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiencies by extra study. When they are made up, he will be received into full standing in his class.

SPECIAL STUDENTS.

Young men who do not desire to take a full regular course can enter and select special shorter courses, with the sanction of the Faculty; but in all cases satisfactory examinations must be passed upon the subjects required for admission to the Freshman class.

ADMISSION TO ADVANCED STUDIES.

Candidates for admission to advanced studies *in any course* are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter.

The additional subjects may be found in the programme of studies.

A diploma or, in so far as it covers the subjects required for admission, a certificate of studies taken at another College will be received in lieu of the *Primary Entrance Examinations only*.

ADMISSION TO THE POST GRADUATE COURSE.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found under the general subject of Graduate Students.

PREPARATORY SCHOOL CERTIFICATES

are not accepted so as to dispense with the primary entrance examination.

NOTE.—The acceptance of a certificate as evidence of proficiency in lieu of examination, is at the discretion of each Professor as to the subjects in his department.

PROGRAMME OF STUDIES,

Showing the number of exercises per week for each subject, and the Text-books used.

The following is presented as the general programme of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees.

The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parentheses immediately following.

Two hours of Drawing, three of work in the Laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

During the year, Prof. Ringer will deliver a course of lectures on the History of Europe, from the Congress of Vienna in 1815 to the Congress of Berlin in 1878.

SCHOOL OF GENERAL LITERATURE.

This school is intended to correspond to the course long established in our older colleges, modified by the needs and requirements of modern culture. Its object is to impart a comprehensive and liberal education to those who design to enter upon professional rather than technical pursuits.

It comprises three distinct courses:

I.—The Classical Course or Course in Arts.

II.—The Latin-Scientific Course or Course in Philosophy.

III.—The Course in Science and Letters.

THE CLASSICAL COURSE.

This course is chiefly designed for those who purpose to study Law and Theology; it includes full and rigorous in-

struction in the Ancient Classics, in Elementary Science and in General Literature. The study of Mathematics in this course embraces Algebra, Geometry, Trigonometry, Analytical Geometry, and the Calculus. The programme includes Physics, Chemistry and Elementary Mechanics. There are full courses in History, in the Science of Language and in the origin and growth of the English Language. There are also lectures on Psychology, the Christian Evidences, International and Constitutional Law and Political Economy. Lectures on English Literature are supplemented by critical readings of the standard English authors. The graduate in this course obtains the degree of Bachelor of Arts (B.A.).

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet) completed. (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)
Greek.—Homer: Odyssey. Prosody. (3)
Latin.—Livy. Prose Composition. (2)
History.—History of Greece. (1)
Physiology and Health.—Lectures. (1)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic tables. (2)
Greek.—Xenophon: Oeconomicus. (3)
Latin.—Cicero: De Amicitia. Horace: Odes and Epodes. Composition and Prosody. (4)
History.—History of Greece. (2) History of Rome. (1)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry. Olney's General Geometry. (4)

Physics.—Lectures. (3)

French.—Languillier and Monsanto's Grammar. Keetel's Analytical Reader. Written and Oral Translations. (2) Or *German.*—Brandt's Grammar. Lodeman's Manual of Exercises. Joynes' Otto's Reader. (2)

Greek.—Herodotus. (2)

Latin.—Tacitus: Agricola and Germania. Composition. (2)

History.—History of Rome. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney. (4)

French.—Grammar. Chardenal's French Exercises. Reader (continued). Coloquial French Drill. E. Aubert. (2) Or *German.*—Grammar. Exercises and Reader (continued). (2)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

History.—Outlines of the World's History. (2)

Greek.—Euripides: Medea. (3)

Latin.—Quintilian: Book X. Horace: Satires and Epistles. Composition. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Outlines of the World's History. (2)

Philosophy.—Coppée's Logic (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Chardenal's Exercises. Written and Oral Translations. Chapsal: Littérature Française. (2)

Or *German.*—Grammar. Translation from German into English and *vice versa.* Reading. (2)

Greek.—Sophocles: Electra. Antiquities. (3)

Latin.—Plautus and Terence. Roman Antiquities: Wilkins. (3)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Schuyler's Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2) Or *German.*—Grammar. Systematic Reading of various authors. Translation. Dictation. (2)

Greek.—Aristophanes: Clouds. (3)

Latin.—Juvenal and Persius. Pliny: Select Epistles. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Grammar. Saintsbury: Specimens of French Literature. Corneille: Le Cid. Feuillet: Le Roman d'un Jeune Homme Pauvre. Lectures on French Literature. Bougeault: Littérature Française. Compositions. (2) Or *German.*—Grammar. Systematic Readings. German Compositions. Lectures on German Literature. Scherr. (3) Conversation Class optional.

Greek.—Pindar: Selected Odes. Greek Literature. (2)
Latin.—Lucretius, with Lectures. Roman Literature. (2)
Essays and Original Orations. (1)
Gymnasium. (2)

SECOND TERM.

Constitutional Law.—Lectures. (1)
History.—History of France. (2)
Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)
Christian Evidences. (1)
French.—Systematic Readings. Compositions. Lectures on French Literature. Lectures in French on Modern French Authors. Bougeault. (2) Or *German.*—Systematic Readings. German Composition. Lectures on German Literature. Scherr: Geschichte der deutschen Literatur. Lectures in German on Modern German Authors. (2)
Geology.—Lectures. Le Conte. (2)
Greek.—Thucydides. Greek Literature completed. (2)
Latin.—Catullus, Tibullus and Propertius. Cicero: de Officiis, with Lectures. Roman Literature (completed). (2)
Lectures on American and English Literature. (2)
Preparation of Thesis.
Gymnasium.

THE LATIN SCIENTIFIC COURSE.

The Latin-Scientific Course leading to the degree of Bachelor of Science (B.S.) is based on Latin without Greek.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet) completed. (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Writing in German Text. Translation into English. (3)

Latin.—Livy. Prose Composition. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Translations: Joynes' Otto's German Reader. (3)

History.—History of Greece. (2) History of Rome. (1)

Latin.—Cicero: De Amicitia. Horace: Odes and Epodes. Composition and Prosody. (4)

English.—Exercises and Declamations. (1)

Gymnasium. (2.)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4.)

Physics.—Lectures. (3)

French.—Languillier and Monsanto's Grammar. Keetel's Analytical Reader. Written and Oral Translations. (2)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Translations from German into English. (2)

History.—History of Rome. (2)

Latin.—Tacitus: Agricola and Germania. Composition. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

French. — Grammar. Chardenal's French Exercises. Reader (continued). Colloquial French Drill. E. Aubert. (2)

German. — Grammar. Systematic Readings of various authors. Translation. Dictation. (2)

History.—Outlines of the World's History. (2)

Latin. — Quintilian: Book X. Horace: Satires and Epistles. Composition. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Outlines of the World's History. (2)

Philosophy.—Coppée's Logic. (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Chardenal's Exercises. Written and Oral Translations. Chapsal: Littérature Française. (2)

German.—Systematic Readings of various authors. Lessing, Herder, Goethe, Schiller. Dictation. Compositions in German. (2)

Latin. — Plautus and Terence. Roman Antiquities: Wilkins. (3)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Schuyler's Psychology. (2) Political Economy. (1)

English. — Earle's Philology of the English Tongue. (2)

French. — Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)

German. — Systematic Reading of various authors (continued). Dictation. Compositions in German. (2)

Latin. — Juvenal and Persius. Pliny: Select Epistles. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History. — Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French. — Grammar. Saintsbury: Specimens of French Literature. Corneille: Le Cid. Feuillet: Le Roman d'un Jeune Homme Pauvre. Lectures on French Literature. Bougeault: Littérature Française. (2)

German. — Systematic Readings of various German authors (continued). Lectures on German Literature. Scherr: Geschichte der deutschen Literatur. Compositions. (2) Conversatioan Class optional.

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy. — History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

Geology.—Lectures. Le Conte. (2)

Latin.—Catullus, Tibullus and Propertius. Cicero: de Officiis, with Lectures. Roman Literature (completed). (3)

French.—Systematic Readings. Compositions. Lectures on French Literature. Lectures in French on Modern French authors. Bougeault. (2)

German.—Lectures on German Literature. Scherr: Geschichte der deutschen Literatur. Lectures in German on Modern German authors. Compositions. (1)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE COURSE IN SCIENCE AND LETTERS.

The Course in Science and Letters, leading to the Degree of Bachelor of Science (B.S.), is designed for those who wish to pursue both Scientific and Literary studies without Latin and Greek. These being omitted, extended instruction is given in French and German, History, General Literature, Mathematics and General Science.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry, (Chauvenet) completed. (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Writing in German Text. Translation into English. (3)

Drawing.—Elementary Projections, Shading and Lettering. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

Physics.—Lectures. (2)

History.—History of Greece. (2) History of Rome. (1)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Translation. Joynes' Otto's German Reader. (3)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Heat, Meteorology, Magnetism and Statical Electricity. Lectures. (5)

French.—Languillier and Monsanto's Grammar. Keetel's Analytical Reader. Written and Oral Translations. (2)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Translations from German into English. (2)

History.—History of Rome. (2)

English.—Exercises and Declamation. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)

Physics.—Galvanism, Light and Acoustics. Lectures. (3)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

French.—Languillier and Monsanto's Grammar. Keetel's Analytical Reader. Written and Oral Translations. (2)

German.—Grammar. Systematic Readings of various authors. Translation. Dictation. (2)

History.—Outlines of the World's History. (2)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Outlines of the World's History. (2)

Philosophy.—Coppée's Logic. (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Chardenal's Exercises. Written and Oral Translations. Chapsal: Littérature Française. (2)

German.—Systematic Readings of various authors. Lessing, Herder, Goethe, Schiller. Dictation. Compositions in German. (2)

Zoology.—Lectures and Laboratory work. Tenney. (2)

Crystallography.—Lectures, with Practical Exercises in the determination of Crystals. (2)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Schuyler's Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)

German.—Systematic Readings of various authors (continued). Compositions in German. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of Minerals. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire. (3)

Philosophy.—Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Grammar, Saintsbury: Specimens of French Literature. Corneille: Le Cid. Feuillet: Le Roman d'un

Jeune Homme Pauvre. Lectures on French Literature. Bougeault: Littérature Française. Composition. (2)

German.—Systematic Readings of various authors (continued . Lectures on German Literature. Scherr: Geschichte der deutschen Literatur. Compositions. (2)

[NOTE.—In both languages, Conversation Class *optional* throughout the year.]

Geology.—Lithology and Laboratory Practice. Formation of Strata. General Definitions of Geology. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

French.—Systematic Readings. Composition. Lectures on French Literature. Lectures in French on Modern French authors. (2)

German.—Lectures on German Literature. Scherr: Geschichte der deutschen Literatur. Lectures in German on Modern German authors. Composition. (1)

Geology.—Historic, Dynamic and Economic Geology. (2)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE SCHOOL OF TECHNOLOGY.

This School includes four distinct courses:

I. The Course in Civil Engineering.
II. The Course in Mechanical Engineering.
III. The Course in Mining and Metallurgy.
V. The Course in Chemistry.

These have the same curriculum of studies for the first term of the Freshman year. At the end of that time the student selects his course and follows its programme.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Chauvenet's Geometry (completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Writing in German text. Translations into English. (3) Or *French.*—Languillier and Monsanto's Practical French Course. Keetel's Analytical Reader. (3)

Drawing.—Elementary Projections, Shading and Lettering. Descriptive Geometry. (2)

English.—Exercises and Declamations. (2)

Physiology and Health.—Lectures. (1)

Gymnasium. (2)

THE COURSE IN CIVIL ENGINEERING.

The special technical studies in this course may be grouped under the heads of Surveying, Applied Mechanics, Road and Railroad Construction, Bridge Design, and Hydraulic and Sanitary Engineering.

The work in Surveying extends over six terms and embraces land surveying, leveling, topography, triangulation, railroad reconnaissance and location, hydrography, and the elements of geodesy. A large equipment of transits, levels and other surveying tools, affords students the opportunity of becoming familiar with the instruments of different manufacturers. Much time is devoted to practice in the field and drafting room, each student being required to become proficient in the use of instruments, in taking field notes, and in map drawing. During the senior year particular attention is paid to the execution of a secondary triangulation of a high order of precision.

The work in Applied Mechanics comprises the strength and elasticity of materials, the theory of the equilibrium of arches, roofs and bridges, that part of the mechanics of machinery which relates to locomotives and hoisting machines, and the theory of hydraulics and hydraulic

motors. Here the theoretical principles are illustrated by examples and problems taken as far as possible from actual engineering practice.

The course in Construction familiarizes the student with the qualities of materials used in engineering structures, with methods of preservation and testing, with masonry and foundations, and with the building and maintenance of roads and railroads. Plans, drawings, and estimates of cost are prepared for the construction of a line of railroad, all details, such as drains, culverts, road crossings, etc., being worked out by each student.

The course in Bridge Design starts with the study of full specifications for a first-class iron highway or railroad bridge. Each student then makes the full computations, designs, working drawings, and bills of material for the particular span assigned him. The weight of the designed bridge is finally determined and compared with the dead load assumed for the calculations. The drawings are made and dimensioned in the same manner as in the drafting office of a bridge company. In connection with this course, visits of inspection to bridges in the vicinity are regularly made.

The work in Hydraulic and Sanitary Engineering embraces the study of systems of water supply, the collection, purification and distribution of water, the combined and the separate systems of sewerage, the methods for the disposal of sewage, and the best practice for the drainage and ventilation of houses. A hydraulic laboratory in the University Park affords opportunity for experiments illustrating the principles of hydraulics, and for the actual measurement of water by means of weirs and orifices.

Besides these special studies there is a course in astronomy which includes practical work in the observatory. The study of English, and of French or German, is continued, and instruction is given during four terms in crystallography, mineralogy, lithology and geology.

The student who completes all the studies of this course will receive the degree of Civil Engineer (C.E.)

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Physics.—Lectures. (2)

German.—Grammar and Exercises (continued). Joyne's Otto's Reader. Translations. (3) Or *French.*—Grammar. Keetel's Reader. Translations. (3)

Drawing.—Projection Drawing. Descriptive Geometry. Freehand Drawing. (4)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Heat, Meteorology, Magnetism and Statical Electricity. Lectures (5)

German.—Grammar. Exercises. Translations. Readings. (2) Or *French.*—Grammar. Chardenal's Exercises. Readings. Translations (2)

Drawing.—Isometric Drawing. Architectural Drawing. (2)

Surveying.—Use of the Chain and Compass. Surveys and Maps of Farms. Colored Topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney. (4)

Physics.—Galvanism, Acoustics, Light. Lectures. (3)

German.—Grammar. Exercises. Systematic Readings. Translations. Dictation. (2) Or *French.*—Grammar. Dictation. Chardenal's Exercises. O'Connor: Choix de Contes Contemporains. (2)

Mechanics.—Mathematical Theory of Motion. Science of Motion in General. Statics. Dynamics, and Statics of Fluids. Lectures on the Theory of Center of Gravity and Moment of Inertia. (4)

Surveying.—Use of the Level and Transit. Profiles and Contour Maps. Determination of Heights and Distances. Topographical Drawing. (3)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Integral Calculus: Courtenay. (2)

German.—Systematic Readings. Translation. Dictation. Compositions. (2) Or *French.*—Translation. Readings. Feuillet: Le Roman d'un Jeune Homme Pauvre. Saintsbury: Specimens of French Literature. (2) Conversation Class optional.

Surveying.—Triangulation. Leveling. Topographical Survey and Map of a large area. (4)

Strength of Materials.—Elasticity and Strength of Wood, Stone, and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction.—Materials of Construction. Masonry. Foundations. Construction of Roads and Pavements. (2)

Crystallography.—Lectures, with practical exercises in the determination of Crystals. (2)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

German.—Systematic Readings. Compositions. Lectures on German Literature: Scherr. Deutsche Literatur. (2) Or *French.*—Reading. Dictation. Compositions. Lectures on French Literature. Bougeault. (2)

Surveying.—Theory of Railroad Curves. Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of cost. (4)

Roofs and Bridges.—Theory and Calculation of Strains in Roof and Bridge Trusses. (2)

Construction.—Stone cutting, with practical Drawings. (3) Construction and Maintenance of Railroads. Theory of Retaining Walls and Stone Arches. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the Determination of Minerals. (3)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Astronomy.—Loomis' Treatise, with Lectures. (3)

Graphical Statics.—Analysis of Stresses in Roof Trusses, Bridge Trusses, and Arches. (2)

Bridges—Suspension and Cantilever Bridges. Design of an Iron Bridge, with Working Drawings. (4)

Surveying.—Use of Plane Table and Sextant. Hydrographic Surveying. Precise Triangulation and Leveling. Stadia Surveying. (3)

Mechanics of Machinery.—Pile Drivers, Cranes, and Elevators. The mechanics of the Locomotive. (2)

Geology.—Lithology, with practical exercises in determining rocks. (2)

Gymnasium.

SECOND TERM.

Astronomy.—Doolittle's Practical Astronomy, with Observatory Work. (2)

Surveying—Elements of Geodesy. The Figure of the Earth. Map Projections Elements of Method of Least Squares. Use of Solar Compass. (2)

Hydraulics.—Hydrostatics. Efflux of water from orifices, and flow in pipes and rivers. Hydraulic motors. (2)

Hydraulic and Sanitary Engineering.—Collection, Purification and Distribution of Water. Systems of Water Supply. The Combined and the Separate System of Sewerage. Dis-

posal of Sewage. House Drainage. Hydraulic Experiments. (5)

Geology.—Historic and dynamic. Le Conte. (2)

Lectures on English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines; the principal subjects taught are: the nature, equivalence and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, Mechanical Technology and the principles and practice of Machine Design.

That the students may obtain the practical engineering data which they will most need when beginning their work as mechanical engineers, they are required to pursue a course of Shop Instruction which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing them with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery Particular attention is therefore directed to the forms and sizes of machine parts that can be readily constructed in the various workshops, to the time that it takes to perform, and the order of, the various operations, to the dimensions most needed by workmen (in order that the students may learn to dimension working-drawings judiciously) and to the various devices - ordinarily escaping the beginner's notice — for increasing the accuracy of the work, durability of the parts, convenience of manipulation and safety of the workmen. This involves acquaintance with the processes and machinery of the workshops, but it is the foreman's and superintendent's knowledge which is required rather than the manual dexterity and skill of the workman and tool

hand The acquirements peculiar to the latter are by no means despised, and students are encouraged to familiarize themselves therewith during leisure hours, but manual work in the shops forms no regular part of the course. On the contrary, the student enters the shop with hands and mind free to examine all the processes, operations and machinery, and ready at any moment at the call of the teacher, to witness an operation of special interest or to examine into the causes of, and remedies for, any sudden breakdown. Dressed in overalls and provided with note-book, pencil, calipers and measuring rule, the student sketches the important parts of the various machine-tools, notes down the successive steps of each of the important shop-processes as illustrated by the pieces operated upon, and, having first obtained a clear idea from the working-drawing of what is about to be constructed, follows pieces of work through the shops from the pig or merchant form to the finished machine.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces which are not being constructed in the shops at the time and the drawings or blue prints for which have been given to them on entering the shops. The student's work is directed not only by these drawings and by the printed programme given him at the start, but also personally by a teacher, who accompanies him into the shops, gives necessary explanations, and tests the extent and accuracy of his knowledge by examining the sketches and notes and by frequent questioning. Finally the results of the observations and the sketches are to be neatly embodied in a memoir.

During the course there are frequent visits of inspection to engineering works, both in and out of town, with special reference to such subjects as Prime Movers, Machinery for lifting, handling and transporting, and Machinery for

changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported upon by the students.

The instruction in Machine Design, during the second term of the Junior year, consists in determining rational and empirical formulas for proportioning such machine parts as come under the head of fastenings, bearings, rotating, sliding and twisting pieces, belt and toothed gearing, levers and connecting rods, also in comparing recent and approved forms of these same parts with respect to their advantages as regards fitness, ease of construction and durability, and in making full-sized working drawings of these parts; all the dimensions are determined by the students from the above mentioned-formulas, the data being given as nearly as possible as they would arise in practice. During the Senior year the students undertake the calculations, estimates and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. From the finished drawings of each machine, tracings are made and then blue prints taken for distribution among the other members of the class. The whole class also take up the design of a steam engine, every dimension being determined by the students, and complete working-drawings made. In the case of the simple machines and of the steam engine, the general plan or arrangement will be given to the students in the form of rough sketches, photographs or wood-cuts This work will continue to the middle of the last term of the Senior year. From this time on the students are expected to make original designs for simple mechanisms, whose object has been fully explained. Throughout the course the work in the draughting room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulas, tables and diagrams.

The graduate in this course will receive the degree of Mechanical Engineer (M.E.).

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

German.—Grammar and Exercises (continued). Joynes' Otto's Reader. Translations. (3) Or *French.*—Grammar. Keetel's Reader. Translations. (3)

Physics.—Lectures. (2)

Drawing.—Projection Drawing. Descriptive Geometry. Freehand Drawing. (4)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Heat, Meteorology, Magnetism and Statical Electricity. Lectures. Barometric leveling and Measurement of heights. (5)

Drawing.—Isometrical Drawing. Architectural Drawing. (2)

Visits of Inspection.—Shops of the vicinity. (2)

German.—Grammar. Exercises. Translations. Readings. (2) Or *French.*—Grammar. Chardenal's Exercises. Readings. Translations. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)

Physics.—Galvanism, Acoustics, Light. Lectures. (3)

German.—Grammar. Exercises. Systematic Readings. Translations. Dictation. (2) Or *French.*—Grammar. Dictation. Chardenal's Exercises. O'Connor: Choix de Contes Contemporains. (2)

Mechanics.—Mathematical Theory of Motion. Science of Motion in general. Statics. Dynamics and Statics of Fluids. Lectures on Theory of Center of Gravity and Moment of Inertia. (4)

Steam Engine.—Rigg's Practical Treatise. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Integral Calculus: Courtenay. (2)

German.—Systematic Readings. Translation. Dictation. Compositions. (2) Or *French.*—Translations. Readings. Feuillet: Le Roman d'un Jeune Homme Pauvre. Saintsbury: Specimens of French Literature. (2) Conversation Class optional.

Mechanical Technology.—Shop instruction. Examination of the processes and appliances involved in pattern making, moulding, forging, fitting and finishing, with sketches and reports. (7)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, shafts and columns. Reports on experimental tests. (4)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

German.—Systematic Readings. Compositions. Lectures on German Literature. Scherr: Deutsche Literatur. (2) Or *French.*—Reading. Dictation. Compositions. Lectures on French Literature. Bougeault. (2)

Kinematics of Machinery. Reuleaux. Nature and Equivalence of Mechanisms. (3)

Machine Design. – Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (5)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Machinery of Transmission.—Weisbach-Herrmann. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Thermodynamics.—General principles; application to Steam Engines and Air Compressors. (3)

Graphical Statics.—Graphical Analysis of Roof Trusses and Girders. (2)

Machine Design.—Calculations and working-drawings for a High-speed Steam Engine. (4)

Kinematics.—Diagrams of the changes of position, speed and acceleration in mechanisms. Link and valve motions. Quick return motions. Parallel motions. Laying out of Cams. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting Machinery, Accumulators, Cranes and Locomotives. (4)

Gymnasium.

SECOND TERM.

Mechanics of Machinery.—Weisbach-Herrmann. Pumps, Pumping Engines, Blowing Engines, Compressors and Fans. (4)

Machine Design.—Calculations and working-drawings for the following machines: Drilling, Shaping, Milling, Shearing and Punching Machines, Hoists, Pumps and Stone Crushers. Original Designs. (5)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels; hydraulic motors. (2)

Measurement of Power.—Indicating of Steam Engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSE IN MINING AND METALLURGY.

In addition to the physics, chemistry, literature, higher mathematics and mechanics necessary to all technical education, the scheme of studies comprises courses in mining, metallurgy, geology, mineralogy, dynamics, qualitative and quantitative analyses, blowpipe analysis, topographical and mine surveying and drawing. On account of the great number and scope of the studies necessary to the completion of this course, it is five years in length.

The graduate in this course will receive the degree of Engineer of Mines (E. M.).

At the completion of the fourth year of this course, the student will receive the degree of Bachelor of Science in Mining and Metallurgy (B.S).

In the course of mineralogy, geology and analytical chemistry, much attention is paid to the practical instruction of the student in determining minerals by their crystallographical and physical properties, and, by the aid of blowpipe analysis, in the determination of rocks; in the qualitative and quantitative examinations of ores and metallurgical products and in the rapid methods of assaying ores by the dry and wet ways employed in metallurgical laboratories. The location of the University in the vicinity of the iron works of the Lehigh Valley and

especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of zinc may be studied at the Bethlehem Zinc Works. The facilities for the practical study of mining and economic geology are not excelled by those of any other Institution in the country. The zinc mines at Friedensville and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the anthracite coal fields of Pennsylvania, the iron and zinc mines of New Jersey, and the celebrated iron mines at Cornwall, Pa.

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic tables. (2)

Chemistry. – Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (3)

Stoichiometry. (1)

Physics.—Lectures. (2)

German.—Grammar and Exercises (continued). Joynes' Otto's Reader. Translations. (3) Or *French.* – Grammar. Keetel's Reader. Translations. (3)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics. — Analytical Geometry: Olney's General Geometry. (4)

Physics. — Heat, Meteorology, Magnetism and Statical Electricity, Lectures. (5)

Drawing. – Freehand Drawing. (1)

Chemical Philosophy.—Cooke. (3)

German.—Grammar. Exercises. Translations. Reading. (2) Or *French.*—Grammar. Chardenal's Exercises. Readings. Translations. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)

Physics.—Lectures. (3)

Mechanics.—Mathematical Theory of Motion. Science of Motion in general. Statics. Dynamics and Statics of Fluids. Lectures on Theory of Center of Gravity and Moment of Inertia. (4)

Chemistry. — Quantitative Analysis: Laboratory Work: Fresenius. (2) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Bronze (Cu, Sn, Zn, Pb)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
5. Copper Ore (Cu)

Drawing.—Projection Drawing. Descriptive Geometry. (3)

German.—Grammar. Exercises. Systematic Readings. Translations. Dictations. (2) Or *French.* — Grammar. Dictation. Chardenal's Exercises. O'Connor: Choix de Contes Contemperains. (2)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Integral Calculus: Courtenay. (2)

Strength of Materials. — Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Crystallography. — Lectures, with Practical Exercises in the determination of Crystals. (2)

Quantitative Analysis. — Fresenius' Quantitative Analysis. (2) The following analyses are executed by the student:

6. Spiegeleisen (Mn)
7. Lead Ore (PbS)
8. Ilmenite (TiO_2)
9. Iron Ore (Complete Analysis)

Assaying.—Including the Assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory Work. Ricketts. (3)

German.—Systematic Readings. Translation. Dictation. Compositions. (2) Or *French.*—Translation. Readings. Feuillet: Le Roman d'un Jeune Homme Pauvre. Saintsbury: Specimens of French Literature. (2) Conversation Class optional.

Literature and History.

Gymnasium. (2)

SECOND TERM.

Mineralogy. — Descriptive Mineralogy, with Practical Exercises in the Determination of Minerals: E. S. Dana. (3)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemistry.—Fresenius' Quantitative Analysis. (5) The following analyses are executed by the student:

10. Limestone (Complete Analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
12. Slag (Complete Analysis)
13. Pig Iron (Complete Analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)

Steam Engine.—Rigg's practical treatise. (3)

Surveying.—Use of Compass, Level and Transit. Maps of Farm Surveys. Profiles and Contour Maps. (2)

German.—Systematic Readings. Compositions. Lectures on German Literature. Scherr: Deutsche Literatur. (2)

Or *French.*—Reading. Dictation. Compositions. Lectures on French Literature. Bougeault. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Geology.—General Geological Definitions and Principles. Dynamic Geology. (3)

Lithology.—Theory, with practical exercises in determining rocks. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (1) The following Analysis is executed by the student:

16. Gas Analysis.

Drawing.—Elements of Colored Topography. (2)

Thermodynamics.—General principles; application to Steam Engines and Air Compressors. (3)

Surveying.—Triangulation. Leveling. Topographical Surveys and Maps. Stadia Measurements. (4)

Gymnasium.

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Mining.—Modes of Occurrences of the Useful Minerals. Searching for Mineral deposits. Examination of Mining Properties. Boring. Mining Tools, Machines and Processes. Timbering and Masonry. Callon. André. (3)

Surveying.—Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of cost. (4)

Geology.—Historic Geology. Lectures. Le Conte. Dana. (2)

Blow-pipe Analysis.—Practice. (1)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Gymnasium.

POST-SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

**Mining.*—Methods of Working. Underground Transportation. Hoisting, Drainage and Pumping. (3) Ventilation and Lighting. Hygiene of Mines. Mine Surveying. (2)

**Mechanics of Machinery.*—Weisbach-Herrmann. Hoisting Machinery, Accumulators, Cranes. (2)

Astronomy.—Descriptive Astronomy: Loomis. (3)

Drawing.—Geological Sections and Maps. (1)

SECOND TERM.

Mining.—Mechanical Preparation of Ores. Coal Washing. (1)

Economic Geology.—Lectures. (1)

Mechanics of Machinery.—Pumps, Pumping-Engines, Blowing-Engines, Compressors and Fans. 4)

Astronomy.—Doolittle's Practical Astronomy, with Observatory Work. (2)

Drawing.—Mining Plant. Systems of Timbering. (3)

Projects.—In Mining, Geology and Metallurgy. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

* The Ventilation, Lighting and Hygiene are completed in the first half of the term by taking four exercises per week. The Mechanics of Machinery is then begun.

THE COURSE IN CHEMISTRY.

In Theoretical Chemistry.—This course begins with lectures on Inorganic Chemistry, in the Freshman year, with recitations on Stoichiometry, followed by recitations for a year in Cooke's Chemical Philosophy and concluded by a course of lectures and recitations on Organic Chemistry.

In Analytical Chemistry, the students take up Qualitative Analysis, by lectures and laboratory practice. During the succeeding year and a half, Inorganic Quantitative Analysis is studied by lectures and laboratory practice, the analyses mentioned below being performed by each student.

Organic Chemistry. — The subsequent year is chiefly devoted to laboratory work in Organic Chemistry, including ultimate Organic Analysis, the determination of vapor densities, the preparation of pure organic substances, their analysis and physical examination, and to original investigation.

Sanitary Chemistry.—Attention is given to the examination of Air, Water, Food and other subjects connected with this study during the Senior year.

Assaying.—The Assaying of ores by furnace assay is taught in the senior year, together with gold and silver bullion analysis by processes as practiced in the United States Mint.

Gas Analysis and Volumetric Analysis are taught in the Junior year.

Industrial Chemistry. — This branch is taught by lectures and laboratory practice. The laboratory for this purpose is supplied with complete working Models for the Manufacture of Illuminating Gas, for the production of Alcohol, and for the Refining of Cane Sugar. It is intended to add to these apparatus for Dyeing, Bleaching and Calico Printing. Instruction will thus be given by practical problems in these branches of Industrial Chemistry, including as well the examination of the raw materials and manufactured products. Various industrial establishments in the immediate vicinity and in New York and Philadelphia are visited by the students in company with an Instructor.

Photographic Chemistry.— This subject is taught by practical work under the direction of a special instructor, in the well-equipped photographic laboratory.

TOXICOLOGICAL AND AGRICULTURAL CHEMISTRY. — Courses of lectures on these subjects are given in the Junior and Senior years.

The course also includes thorough instruction in Physics, Mineralogy and Blow-pipe Analysis, Metallurgy and Geology.

The last term of the Senior year is mainly devoted to the preparation of a Thesis on some subject, selected by the Professor, involving practical work in the Laboratory in addition to the literary labor, and each graduate will thus make a contribution to the progress of the science as a preliminary to the reception of his degree.

The course is thus seen to include thorough instruction in theoretical and applied chemistry, in their various branches, as well as in those cognate sciences which are of such great value to the chemist.

The Laboratories are under the immediate charge of the Professor and his Assistants, and, together with the Lecture-room, are unsurpassed in excellence by any similar establishment in the country, being supplied with all the modern improvements. The collections of apparatus, specimens and models, illustrating theoretical and applied chemistry, are already important and rapidly increasing.

Students are charged for the chemicals and apparatus consumed. If the student is moderately careful, this expense need not exceed $50 per year.

The graduate of this course will receive the degree of Analytical Chemist (A.C.).

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (3)

German.—Grammar and Exercises (continued). Joynes' Otto's Reader. Translations. (3) Or *French.*—Grammar. Keetel's Reader. Translations. (3)

Physics.—Lectures. (2)

Stoichiometry. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Chemical Philosophy.—Cooke. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (4)

The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Potassium Dichromate (Cr_2O_3)
3. Barium Chloride (Ba, Cl, H_2O)
4. Magnesium Sulphate (MgO, SO_3, H_2O)
5. Disodium Hydrogen Phosphate (P_2O_5)
6. Bronze (Cu, Sn, Zn, Pb)
7. Rochelle Salt (K_2O, Na_2O)

Quantitative Analysis—Conference. (1)

Physics.—Heat, Meteorology, Magnetism and Statical Electricity. Lectures. (5)

German.—Grammar. Exercises. Translations. Reading. (2) Or *French.*—Grammar. Chardenal's Exercises. Readings. Translations. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Physics.—Galvanism, Acoustics, Light. Lectures. (3)

German.—Grammar. Exercises. Systematic Readings. Translations. Dictation. (2) Or *French.*—Grammar.

Dictation. Chardenal's Exercises. O'Connor: Choix de Contes Contemporains. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

8. Volumetric Determination of Chlorine.
9. Acidimetry (HCl, H_2SO_4, HNO_3, $HC_2H_3O_2$)
10. Alkalimetry (KOH, NaOH, NH_4OH, Soda Ash, Pearl Ash)
11. Chlorimetry (Bleaching Powders)
12. Silver Coin (Au, Ag, Pb, Cu)
13. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
14. Copper Ore (Cu)
15. Spiegeleisen (Mn)
16. Lead Ore (Pb, S)
17. Ilmenite (TiO_2)
18. Iron Ore (Complete Analysis)
19. Limestone (Complete Analysis)
20. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
21. Slag (Complete Analysis)

Quantitative Analysis.—Conference. (1)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemical Philosophy. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Toxicology.—Lectures. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

22. Guano (NH_3, P_2O_5, H_2O)
23. Clay (Complete Analysis)

24. Manganese Ore (MnO_2)
25. Mineral Water (Complete Analysis)
26. Pig Iron (Complete Analysis)
27. Nickel Ore (Ni, Co)
28. Carbon in Steel (Volumetric)
29. Gas Analysis.

Quantitative Analysis.—Conference. (1)

Organic Chemistry.—Lectures and Recitations. (4)

Crystallography.—Lectures, with Practical Exercises in the Determination of Crystals. (2)

German.—Systematic Readings. Translation. Dictation. Compositions. (2) Or *French.*—Translation. Readings. Feuillet: Le Roman d'un Jeune Homme Pauvre. Saintsbury : Specimens of French Literature. (2) Conversation Class optional.

Literature and History.

Gymnasium. (2)

SECOND TERM.

Organic Chemistry.—Laboratory. (5)

Organic Chemistry.—Conference. (1)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

German.—Systematic Readings. Compositions in German. (2) Or *French.* — Systematic Readings. Compositions. (2)

Mineralogy.—Descriptive Mineralogy, with Practical Exercises in the Determination of Minerals. E. S Dana. (3)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

Metallurgy.— Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Assaying.—Including the Assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Ricketts. (3)

Organic Chemistry.—Laboratory. (4)

Organic Chemistry.—Conference. (1)

Geology.—Lithology, with Practical Exercises in determining rocks. (3)

Gymnasium.

SECOND TERM.

Industrial Chemistry.—Lectures and Laboratory. (4)

Agricultural Chemistry.—Lectures. (1)

Sanitary Chemistry.—Laboratory. (1)

Geology.—Historic and Dynamic Geology. Lectures Le Conte. (2)

Christian Evidences.—Lectures. 1)

Lectures on American and English Literature. (2)

Preparation of Thesis. (5)

Gymnasium.

THE ADVANCED COURSE IN ELECTRICITY.

[NOTICE.—This course will be continued during the next University year of 1887–88; after which it will be replaced by the new four years' course in Physics and Electrical Engineering.]

This course has been established to answer the growing demand for more extensive and thorough knowledge of the subject of Electricity and its application to Machines, Telegraphy, Electric Lighting, etc.

Instead of an extended department of Electrical Engineering including full courses of Mathematics, Mechanics, Chemistry, etc., and extending over four years, it is thought best to offer for the present a course, occupying not more than one year and presenting very fully the purely electrical portion of an Electrical Engineering course, with only such outside branches as are absolutely necessary for the proper understanding of this single subject.

Those persons whose time is limited and who desire to take up any of the leading industrial applications of Electricity; or those, who having already been engaged in such work, are familiar with the practice, but wish to gain a knowledge of the theory and scientific principles involved, will find this course very desirable.

During the past year the scope of the course has been widened so as to accomplish another purpose. The facilities for the study of the other branches of Physics—Mechanics, Heat, Light and Meteorology—have been greatly increased; so that any one wishing to take a special course in Physics alone, will find in this department a better opportunity for attaining his object than is afforded by the regular curriculum of the University.

FIRST TERM.

Magnetism and Electricity.—Text-book (S. P. Thompson) and Lectures. Electrical Arithmetic (Day's). (5)

Mechanics.—(Laboratory work.) Precise Measurements with beam-compass, spherometer, cathetometer, micrometers, etc. Testing balances. Specific gravities of solids, liquids and gases by all known methods, with balances, hydrometers, comparison of densities and cathetometer, etc.; with corrections for temperature and buoyancy of air, etc. Laws of gravity, with determinations by Atwood's machine, pendulum, etc. Elasticity; Young's modulus by stretching, flexure and torsions, tenacity of wires, superficial tension by capillary tubes of different liquids. Work with mercurial and aneroid barometers, with all corrections and reductions, to freezing point, sea level, etc.; measurement of heights and leveling roads. (3)

Magnetism and Static Electricity.—(Laboratory work.) Making and testing permanent magnets. Verification of laws by Coulomb's torsion balance. Measurements of portative force, strength of pole, effects of heating, percussion, etc. Study of the distribution of magnetism and drawing

magnetic curves. Investigation of local attraction, variation of magnetic needle and intensity of the earth's magnetism.

Construction of electroscopes, condensers. Determination of electrical character of many substances. Verification of laws of electrical attraction and repulsion. Measurements of conductivity, electric density and capacity. Study of laws of Static induction, specific inductive capacity, etc., and of condensers. Analysis of machines, electrophorus, plate glass machines, Holtz's, etc. (5)

Meteorology.—Text-book (Loomis) and practice. Observations for one month as taken in the U. S. Signal Service stations; with all the usual corrections and reductions; construction of charts; mapping curves, etc. (5)

Drawing.—Elementary Projections. Freehand Drawing. (3)

SECOND TERM.

Dynamic Machinery.—Text-book (S. P. Thompson) and lectures.

Electric Lighting.—Text-book (Du Moncel) and lectures.

Telegraph.—Lectures. (5)

Sound, Heat and Light.—(Laboratory work.) Determination of number of vibrations of notes with Siren, comparison of pitch of tuning forks. Determination of velocity of sound in air. Verification of laws of vibrations of strings. Determination of absolute pitch of notes by the monochord and of wave lengths of notes by sensitive flames. Making and testing thermometers; determinations of freezing and boiling points of different substances; of coefficients of expansion of solids, liquids and gases; of specific heat of bodies by the known methods and of latent heat of fusion and vaporization. Humidity by various methods. Verification of the laws of light. Photometry; testing intensities of lights with Bunsen's, Rumford's, Foucault's and daylight photometers. Tests of absorptive power of different substances. Index of Refraction of unknown substances by various methods. Measurements of focal lengths of

lenses and mirrors. Construction of optical instruments, finding magnifying power, etc. Spectroscopic work; mapping Frauenhofer lines; identification of unknown substances in solution; absorption spectra (solids and liquids); comparison of spectra; mapping of spectra. Interference. Diffraction spectra. Construction of polariscopes; laws of polarization by reflection and double refraction. Study of uniaxial and biaxial crystals. (3)

Dynamic Electricity.—(Laboratory work.) Setting up, use and care of all batteries in common use, Grove's, Daniel's, LeClanchè's, Bichromate, Bunsen's, Smee's, Gravity, etc.; Secondary batteries, Plantè's, Faure's. Construction of electro-magnets; tests for portative force and strength of pole under varying conditions of current strength, size of wire, number of coils, length and diameter of cores, etc. Laws of currents. Electro-Dynamics. Testing thermo-electric batteries, Noë's and Clamond's. Electrolysis, electrotyping and electroplating. Making induction coils; testing different orders of induced currents and extra currents. Similar study of magnetic induction. Analyses and tests of electro-magnetic and dynamic machines. Diamagnetism. (5)

Electrical Measurements.—(Laboratory work.) Practical construction of instruments; sine, tangent and differential galvanometers, ammeters, voltameters, resistance coils, commutators, etc. Verification of Ohm's laws under varying conditions of electromotive force and external and internal resistance. Measurement of resistance of solid and liquid conductors in single and divided circuits; and of effects of change in temperature: of internal resistance, electromotive force and current strength of voltaic batteries. Measurements of quantitative laws of electrolysis, comparisons of voltameters and galvanometers. Testing electric lights, measurements of potential of incandescent lamps; their resistance, hot and cold and amount of heat units given off. Photometric measurements of incandescent lamps; Swan's, Lane-Fox's, Maxim's, Edison's, etc.; and of arc lamps, Weston's, Thompson-Houston's, etc. Spec-

troscopic study of all these lights and mapping their spectra.

Photographing the lines of force of the field magnets of various types of dynamos. Measurements of current strength, difference of potential and resistance of dynamos. Study of different plants and systems of dynamos by visits to manufactories and working systems.

Telegraphic measurements; measuring and testing lines for conductivity, insulation, location of faults, etc. (2)

NEW FOUR YEARS' COURSE IN PHYSICS.

At the October meeting of the Trustees of the University, it was determined to establish a four years' course, involving a full development of the branches of Physics and Electrical Engineering. This course will begin in September, 1888, and will replace the present one year's Advanced Course in Electricity. A degree will be given with it. The details of the course will appear in next year's Register.

PHYSICAL CULTURE.

The Gymnasium is open morning, afternoon and evening, in all, 45 hours a week. Exercise in it is required of all students who are fitted to take it. Class drill with the Instructor and individual exercise are prescribed.

GRADUATING THESES.

Every student will be required to present a thesis upon some topic connected with his special course, as a necessary portion of the exercises for his final examination for a diploma. These theses shall be accompanied by drawings and diagrams, when the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the President.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the President and Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate, signed by the President and the Secretary of the Faculty, is given showing what the student has accomplished.

GRADUATE STUDENTS.

Graduate students wishing to remain a year or more and pursue a course of study as candidates for another Degree may do so with the sanction of the Faculty. Those wishing to take *special* courses of study will be afforded every facility for so doing.

POST GRADUATE DEGREES.

M. A.

The Faculty will recommend for the Degree of Master of Arts any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Arts, shall pursue, for at least one year at this University, or two years elsewhere, a course of liberal study prescribed by the Faculty in at least two departments, pass a satisfactory examination in the same and present a satisfactory Thesis.

M. S.

The Faculty will recommend for the Degree of Master of Science any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Science, or any Degree in the School of Technology, shall pursue, for at least one year at this University, or two years elsewhere, a course of study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

Ph. D.

The Faculty will recommend for the Degree of Doctor of Philosophy any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Master of Arts or Master of Science, shall pursue, for at least one year at this University, or two years elsewhere, a course of advanced study prescribed by the Faculty, pass a thorough examination in the presence of the Faculty in the same and present a satisfactory Thesis giving evidence of original investigation.

The Candidate shall have a good knowledge of Latin and either French or German.

The Theses presented by Candidates for Post Graduate Degrees shall be retained by the University.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of One Hundred Thousand Dollars, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than Twenty Thousand Dollars were contributed by her family and friends, as a memorial fund for the purchase of books. By the will of the Founder of the University a fund of $500,000 has been given for the permanent endowment of the library.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior, the center is occupied as a reading space, fifty by forty feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for Eighty Thousand Volumes. The building is thoroughly fireproof, well lighted, and heated by steam.

Sixty-three thousand volumes are now upon the shelves, including many extremely valuable works. The list of periodicals numbers about one hundred and twenty-five, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

REGULATIONS OF THE LEHIGH UNIVERSITY LIBRARY.

I. The Library is open every day, except Sundays and Legal Holidays, from 8 A. M. until 10 P. M., and on Sundays for the students and others connected with the University from 1.30 P. M. until 9.30 P. M.

II. Admission is free to all persons over 16 years of age.

III. Readers are required to write their names and addresses in the Daily Register of the Library. They also write the name of the book desired upon a Library Card, with their signatures, and present the same to the Director's Clerk, who supplies the book, retaining the card as a receipt. Before leaving the Library, readers return their books to the clerk, and receive their cards.

IV. No book is permitted, under any circumstances, to be taken from the Library.

V. No person is allowed to enter the alcoves, or remove any book from the shelves, without permission of the Director.

VI. Readers wishing to consult the more valuable illustrated works make special application for that purpose.

VII. In taking notes, pencils, and not pens and ink, are to be used.

VIII. Audible conversation and the use of tobacco are strictly forbidden in any part of the Library.

IX. Any person not conforming to these Regulations, will be denied the privilege of the Library.

X. Any person, who defaces, in any way, any book, magazine or paper, or the furniture, or any portion of the building, in addition to being deprived of the privileges of the Library, will be prosecuted according to law.

OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the Observatory is mounted an Equatorial Telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a superior Sidereal Clock, by Wm. Bond & Sons; a Zenith Telescope, by Blunt, and a Field Transit, by Stackpole. There is also a Prismatic Sextant, by Pistor & Martins.

Students in Practical Astronomy receive instruction in the use of the instruments and in actual observation.

The grounds upon which the Observatory stands, consisting of seven acres of land adjoining the original grant, was presented to the University by Charles Brodhead, Esq., of Bethlehem.

An advanced course in Astronomy and the higher Analysis has been established, requiring two years for its completion. It is adapted to the attainments of the graduates of this University, but, is open to any one who may be prepared to pursue it.

This course embraces the following subjects:

First Year.—Spherical Astronomy. Theory of Instruments. Method of Least Squares. Numerical Calculus.

Second Year.—Celestial Mechanics. Interpolation and Quadrature. Computation of Orbits and Perturbations.

During the entire course the student will have ample opportunity to familiarize himself with the practical work of the Observatory and Computing Room.

THE ENGINEERING SOCIETY.

This society was organized in 1873, and admits, by election, students in the Junior and Senior Classes. Its meetings are held fortnightly. At these, papers relating to engineering subjects are read and discussed. It issues quarterly "The Journal of the Engineering Society" to which the members and others contribute.

THE AGORA

is a Literary Society which meets semi-monthly—only students in the Course of General Literature are eligible to membership.

THE ATHENÆUM.

is also a Literary Society whose active membership is confined to the Sophomore Class. The meetings are held weekly.

FOUNDER'S DAY.

On the second Thursday of October of each year Commemorative Exercises are held in honor of the Founder of the University.

On Thursday, October 14, 1886, the Eighth Founder's Day was celebrated. An appropriate service was held in the Chapel and an address was delivered by the Hon. Richard Vaux, of Philadelphia.

WASHINGTON'S BIRTHDAY.

This day is observed as a holiday.

On Monday, February 22, 1886, exercises were held in the Chapel. Professor Green's tribute to Washington and a part of the Farewell Address were read by Mr. Bonnot and orations were delivered by Messrs. Pollak, Terrell, Richards, Fisher, Stoek and Howard of the Junior Class.

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day.

The Rt. Rev. Cortlandt Whitehead, D.D., Bishop of Pittsburgh, was the preacher on Sunday, June 20 , 1886, in the University Chapel.

THESES.

Theses on the following subjects were prepared by the graduating class of 1886.

"The Growth of Pauperism."

CHARLES RODNEY BOOTH.

"Review of the three-track railroad bridge at East Penn. Junction, Pa."

JOHN HENRY BROWN.

"What is the best Form of Government?"

CHARLES ELLSWORTH CLAPP.

"Design for a quarter-cut-off valve-gear."

GEORGE HENRY COBB.

"The Ventilation of Mines."

"On Ptomaines or the Preparation of Artificial Alechanin and Purpurine.

WILLIAM HENRY DEAN.

"The Stability of Retaining and Reservoir Walls.

FREDERICK WILLIAM FINK.

"A Comparison of the Iron Pipe and Fire Brick Hot Blast Stoves."

WILLIAM BANKS FOOTE.

"A History of the Development of Bridge Building in the United States."

ROBERT CALDWELL GOTWALD.

"Design for an Iron Highway Bridge over the Jordan Creek, Allentown, Pa."

LEWIS JOHN HENRY GROSSART.

"On the Estimation of Iron by Succinic Acid."

MAX SIGISMUND HANAUER.

"Review of the Iron Railroad Bridge over the Lehigh River, at Bethlehem, Pa."

SOLOMON JACOB HARWI.

"The Dillsburg Iron Ore Deposit."

IRVING ANDREW HEIKES.

"The Development of the Greek Drama."

MARK ANTONY DE WOLFE HOWE, JR.

"A Comparison of the Precision of Three Engineers' Transits."

CHARLES ALEXANDER JUNKEN.

Theory of Hydraulic Motors with design of a Hydraulic Governor."

GAUDALUPE LOPEZ DE LARA.

"The Construction, Operation and Decay of the Union Canal."

PAUL DOUGLASS MILLHOLLAND.

"A Comparison of the Cost of Steam and Electricity as motive power for an Elevated Railroad.

HENRY GERBER REIST.

"On Aluminum."

JOSEPH WILLIAM RICHARDS.

"On the Preparation of Artificial Indigo."

GEORGE MANN RICHARDSON.

"The Law of Condensation in Steam Engine Cylinders."

AUGUSTUS STOUGHTON ROSS.

"Charters and Chartism."

GEORGE ARTHUR RUDDLE.

"The Errors of the Steam Engine Indicator."

WILLIAM HEYSHAM SAYRE, JR.

"On Map Projections; with a determination of errors in distance and azimuth near latitudes 40° and 41° for Mercator and polyconic projections to a scale of 1 : 400,000."

JOHN SELMAR SIEBERT.

"Discussion of Formulas and Experiments on the Strength of Columns."

JOHN HENRY SPENGLER.

"Dickens as a Social Reformer."

WILLIAM PATTERSON TAYLOR.

"Geography's Part in the Science of History with Special Reference to the History of England."

HARRY TOULMIN.

"The Rod-Float as a Velocity-meter."

CURTIS HUSSEY VEEDER.

THE ADDRESS BEFORE THE ALUMNI

was delivered on the evening of Alumni Day, June 23, 1886, in the Drawing Room of Packer Hall, by Prof. Samuel P. Sadtler, Ph.D., F.C.S., of the University of Pennsylvania.

UNIVERSITY DAY.

This day is the last of the academic year and falls in 1887 on the fourth Thursday in June. On this day orations are delivered by members of the Graduating Class, and Degrees are conferred.

EXERCISES ON JUNE 24, 1886.

Reading of Scriptures and Prayer by the Rt. Rev. M. A. de Wolfe Howe, D.D., LL.D., Bishop of the Diocese.

Salutatory Oration.

HARRY TOULMIN.

Oration.—"Heroes of Science."

JOSEPH WILLIAM RICHARDS.

Oration.—"The Political Problem."

JOHN HENRY SPENGLER.

Oration.—"The Formation of Character."

EDWIN STANTON STACKHOUSE.

Oration.—"Perfect Manhood."

WILLIAM PATTERSON TAYLOR.

Oration, with Valedictory Addresses.—"The Printing Press."

SOLOMON JACOB HARWI.

Award of the Wilbur Scholarship to

SAMUEL WILSON FRESCOLN,

of Reading, first in rank in the Sophomore Class,

with honorable mention of

LUTHER REESE ZOLLINGER,

of Harrisburg, second in rank.

Award of Certificates for the Advanced Course in Electricity.

The following Degrees were conferred :

B. A.

Mark Antony De Wolfe Howe, Jr.,
William Patterson Taylor.

B. Ph.

George Rodney Both, George Arthur Ruddle,
Charles Ellsworth Clapp, Harry Toulmin.

C. E.

John Henry Brown, Solomon Jacob Harwi,
Frederick William Fink, Chas. Alexander Junken,
Robert Caldwell Gotwald, Paul DouglassMillholland
Lewis John Henry Grossart, John Selmar Siebert,
John Henry Spengler.

M. E.

George Heny Cobb, Augustus Stoughton Ross,
Guadalupe Lopez De Lara, William Heysham Sayre, Jr.
Henry Gerber Reist, Curtiss Hussey Veeder.

B. M.

William Henry Dean, Edwin Stanton Stackhouse,
Simeon Cole Hazelton, Theodore Stevens,
Charles Aug. Luckenbach, Joseph Kiddoo Surls,
William Anthony Lydon, Priestley Toulmin.

A. C.

William Henry Dean, Max Sigismund Hanauer,
Joseph William Richards, George Mann Richardson.

E. M.

William Henry Dean, Irving Andrew Heikes, B.M.
William Banks Foote, B.M., Francis Henry Purnell, C.E.

The Benediction was then pronounced by the Bishop.

The music upon University Day was by the Germania Orchestra.

THE WILBUR SCHOLARSHIP.

This Scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE ALUMNI SCHOLARSHIP.

The Alumni Association of the University has established a Scholarship of the value of $250 per annum, subject to the following conditions:

1. That the Scholarship shall only be awarded to a student really in need of it.
2. That the Scholarship shall not apply to the first year of any student's course; he must without this aid have gone through one year, and must be prepared to start the second year free from all conditions.
3. That the Scholarship shall not be continued to a student who shall at any time during his course carry any condition over eight weeks beyond the date of the examination in which he failed.

Subject only to the above conditions the disposal of the fund shall until otherwise directed be in the hands of the President of the University.

WILBUR PRIZE.

By the generosity of E. P. Wilbur, Esq., a fund has been established yielding an annual income of $100, for distribution in prizes as the Faculty shall determine.

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of the Lehigh University" has established an Annual Sum of Fifty Dollars, to be distributed as prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The Contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the oration shall be announced at the beginning of the first Term of every year and upon one of these, each competitor shall write an oration not to exceed eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do —should they be sufficient in number - the best six shall be chosen, and their envelopes opened. The others shall be returned to the address given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors, whose oration shall have been approved, and the awards shall be made by a majority of these Judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

At the last contest, the First Prize was awarded to

GEORGE THOMAS RICHARDS,

and the Second, to

HARVEY SHEAFE FISHER.

The next contest will take place February 22, 1887.

ENTRANCE EXAMINATION PAPERS.

Used at the Examinations in 1886.

[Requests for other examination papers than those herein printed can not be granted.]

I.—ENGLISH GRAMMAR.

"The *best* authors *should be read* by the *student*, *that* he may *thus* insensibly *acquire* a grace and *refinement* of expression *which no* arbitrary rules can give."

1. (*a*) Parse *best* in the above sentence. (*b*) State the voice, mood, tense, person and number of *should be read*. (*c*) Decline *student*. (*d*) Parse *that*. (*e*) In what mood is *acquire?* (*f*) In what case is *refinement?* (*g*) Parse *which*. (*h*) Change each *active* clause into its equivalent passive form, and *vice versa*, and write out the full sentence in this changed form. (*i*) Into what simple clauses can the sentence be separated? (*j*) Give the subject and predicate of each simple sentence. (*k*) Parse *thus*. (*l*) What parts of speech are not contained in it? (*m*) Parse *no*. (*n*) What *irregular* verbs are contained in it?

2. Write a simple sentence containing an adjective and an adverbial phrase.

3. Give a synopsis of the verbs *see* and *sit* in the 1st person plural of all moods.

4. (*a*) What is a *suffix?* (*b*) What is the primitive of *indescribable?* (*c*) How are adjectives regularly compared? (*d*) What is the difference between and adjective and an adverb? (*e*) In the sentence, *If is a conjunction*, what part of speech is *if?*

5. Correct the following sentences, and give the reason for the correction: (*a*) I done as well as I could. (*b*) Set down and rest. (*c*) Whom do men say that I am? (*d*) We hoped to have heard from you before this. (*e*) I do not know who she went with.

6. Write a *proper* noun; a *common* noun; a *collective* noun; an *abstract* noun.

7. Give the possessive plural form of *motto*, *lady*, *thou* and *man*.

8. Write an *ordinal* adverb; an adverb of *manner;* an adverb of *degree*.

9. Write a letter of not less than 200 words to the President of the Lehigh University on the subject of admission to the University; state what course you propose to enter and *why* you propose to take that course.

10. Analyze and parse the following sentence: Can the branch improve when taken from the stock which gave it nourishment?

II —GEOGRAPHY.

1. Give the geographical center of the United States, the center of population.

2. Describe Alaska.

3. Name in order the five States of highest population, and the five of largest area.

4. In what States are Burlington, Springfield, Portland, and Charleston?

5. Draw a map of New England, indicating the chief cities, rivers, and mountain ranges.

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6. What islands in the Atlantic belong to Great Britain?

7. What States of South America lie in the temperate zone?

8. What parts of the Eastern Hemisphere have the same latitude as Cuba?

9. Mention five chief cities of Germany, and five of Italy.

10. Where are New Zealand, New Guinea, Malta, Iceland, and the Isle of Wight?

III.—UNITED STATES HISTORY.

1. Who settled about Massachusets Bay? Did the Puritans tolerate other churches? What was the difficulty with Roger Williams? What settlement did he found?

2. Cause of Pontiac's War? its result? fate of Pontiac?

3. When was Philadelphia captured by the British? when and where did the French fleet arrive?

4. Which day was Washington inaugurated? what were the difficulties with France?

5. Alien and Sedition Laws—their character? under whose administration were they passed?

6. When was the Treaty of Ghent made? after which war?

7. Who proposed, and who seconded the compromise of 1850? its condition?

8. What were the results, what was the situation after the first year of the Civil War?

9. Battle of Chattanooga, date? who commanded the Union forces? who the Confederates?

10. When can the privilege of the writ of Habeas Corpus be suspended?

11. What changes in the election of the President have been introduced by the 12th amendment?

12. What constitutes treason against the United States?

IV.—ARITHMETIC.

1. Reduce $\left(\frac{1\frac{3}{4}}{4\frac{1}{2}} \div \frac{2\frac{1}{3}}{2\frac{1}{4}}\right) \times \frac{4}{5} \times \frac{1}{2}$ to a decimal.

2. In 3 miles 2 rods 10 feet how many meters?

3. Having sold 36 % of my land I have 224 acres left. How much land had I at first?

4. What is the interest, discount, and bank discount on $127.42 for 65 days at 5 %?

5. Find the annuity whose amount for five years at 6 % compound interest is $2818.546.

6. What part of 4 is $\frac{4}{9}$ of 6?

a How many inches in a foot? In a meter? In a link?

b Give rules for position of decimal point in multiplication and division.

c Explain method of converting decimal to common fraction.

d Explain method of finding least common multiple of quantities.

e What are stocks? What are bonds?

V.—GEOMETRY.

1. The three bisectors of the angles of a triangle meet in a point.

2. In the same circles, or in equal circles, equal chords are equally distant from the center; and of two unequal chords, the less is at the greater distance from the center.

3. Two incommensurable ratios are equal if their approximate numerical values are always equal when both are expressed within the same measure of precision, however small.

4. An angle formed by two secants intersecting without the circumference is measured by one half the difference of the intercepted arcs.

5. Upon a given straight line to describe a segment which shall contain a given angle.

6. If a straight line divides two sides of a triangle proportionally, it is parallel to the third side.

7. The square described on the hypothenuse of a right triangle is equal to the sum of the squares described on the other two sides.

8. Given the radius and apothem of a regular polygon, to compute the radius and apothem of the isoperimetric polygon of double the number of sides.

9. If a regular polygon be constructed with a given perimeter, its area will be the greater, the greater the number of sides.

10. Every point in a plane which bisects a diedral angle is equally distant from the faces of that angle.

(*a*) What is a surface? A plane? A point?

(*b*) What is a circle? A segment? A sector? A tangent? A secant?

(*c*) What are the different cases in which two triangles are equal to each other?

(*d*) When is a figure symmetrical with respect to a line?

(*e*) What is the projection of a point on a line? Of a line on another line?

(*f*) What is a polyedral angle? What are symmetrical polyedral angles?

VI.—ALGEBRA.

1. Show when $x^m + y^m$ is divisible by $x + y$.

2. $\left(\frac{5}{2(x+1)} - \frac{1}{10(x-1)}\right) - \frac{24}{5(2x+3)} = \text{what?}$

3. Expand the following expressions by the binominal formula:

$$(1 - x^{\frac{1}{4}})^2, \qquad (1 - x^2)^{\frac{1}{2}}.$$

4. Extract the square root of 3.1415926, and give reasons for the various steps of the process.

5. Reduce the following to equivalent expressions having rational denominators:

$$\frac{3}{\sqrt{5}+\sqrt{2}}, \qquad \frac{2}{\sqrt[3]{5}-\sqrt[3]{4}}, \qquad \frac{2}{\sqrt{5}+\sqrt{3}-\sqrt{2}}.$$

6. Find the value of x in each of the following equations:

$$\frac{9x+20}{36} = \frac{4x-12}{5x-4} + \frac{x}{4}, \qquad \sqrt{x-32} = 16 - \sqrt{x}.$$

7. Find the values of x, y, and z from the following equations:

$$\frac{a}{x} + \frac{b}{y} = 1, \qquad \frac{b}{y} + \frac{c}{z} = 1, \qquad \frac{c}{z} + \frac{a}{x} = 1.$$

8. Solve the following equations:

$$\frac{x+a}{x-2a} + \frac{x-2a}{x+a} = 1, \qquad (x-a)(x-b)(x-c) = 0,$$

$$x^2 + xy + y^2 = 52, \qquad xy - x^2 = 8.$$

a. What is meant by the degree of an equation?

b. What is an imaginary quantity? Is the product of two imaginary quantities real or imaginary?

c. What is a geometrical progression?

d. What is a proposition? An axiom? A corollary? A postulate?

e. What is a prime number? A composite number? A polynominal?

f. What operations may be performed on an inequality without changing the sense of the inequality?

VII.—PHYSICS.

1. Define
   a. Momentum?
   b. Elasticity?
   c. Gravitation?
   d. Potential energy?

2. Find the energy of a body weighing 5 lbs. and moving with a velocity of 45 feet per second?

3. A power of 4 lbs. keeps in equilibro a weight of 176 lbs. by means of a wheel, whose diameter is 11 feet. What is the diameter of the axle?

4. A body moving with a uniformly accelerated motion traverses 1000 meters in 10 seconds. What would be the space traversed in the 18th second?

5. A piece of glass weighs in air 4320 grains, in water 3195 grains, in sulphuric acid 3072 grains; find the specific gravities of
   a. the glass:
   b. the acid.
   c. What is the volume of the glass?

(A cubic ft. of water weighs 62½ lbs.)

6. How are echoes produced?

7. What weight of ice at 0° C. will be melted if put in 4 lbs. of water at 50° C.?

8. What is the numerical value of the latent heat of steam?

9. What is radiant heat?
10. Are images made by the following instruments larger or smaller than the objects?
    a. Concave mirrors.
    b. Convex mirrors.
11. Explain double refraction?
12. What is magnetic induction?
13. In a Grove's cell, which is
    a. the positive pole?
    b. the positive plate?
    c. the direction of the current in the liquid?
14. Describe the electro-maget.

VIII.—LATIN.

I.—GRAMMAR.

1. Decline throughout, and give the gender of—*gente, mulieribus, nomine, paludes, senatores, arma.*

2. Decline *millibus*, and explain the differences observable between the singular and plural of this word; also decline *tres.*

3. Give the principal parts of the verbs—*redacto, collectos, miserunt, dediderunt, ferre, cado, cædo, cedo, scindo.*

4. Write out the present and pluperfect subjunctive of—*arbitrarentur, ferre, possent.*

5. Decline throughout and give the gender of—*militum, hoste, agmine, colle, castris, loco, colonum, spe, salutis, corporibus, cadaveribus, flumen.*

6. Give the principal parts of—*constiterat, inferrent, timerent, resistere, gererentur, cognovissent, præstiterunt, jacentibus, dejectis, deberet, ascendere, subire, redegerat, direptis, auderent.*

7. Decline *duarum*, and all other declinable cardinal numbers under 10.

8. Write out present and imperfect subjunctive of *potitus*, and the first person of all the tenses of *cœperunt.*

9. What are the degrees of comparison of—*extrema*, *proximi*, *prope*, *latissimum*, *facilia*, *creber*, *arduus*, *dives*, *frugi*, *benevolus?*

II.—CAESAR.

Translate:

Biduo post Ariovistus ad Caesarem legatos mittit: 'Velle se de his rebus, quae inter eos agi coeptae neque perfectae essent, agere cum eo: uti aut iterum conloquio diem constitueret, aut, si id minus vellet, e suis legatis aliquem ad se mitteret.' Conloquendi Caesari causa visa non est; et eo magis, quod pridie ejus diei Germani retineri non poterant, quin in nostros tela conicerent. Legatum e suis sese magno cum periculo ad eum missurum, et hominibus feris objecturum existimabat.

B. G., I., 47.

III.—VIRGIL.

Translate:

D. Phyllida mitte mihi: meus est natalis, Iolla;
Cum faciam vitula pro frugibus, ipse venito.
M. Phyllida amo ante alias; nam me discedere flevit,
Et longum Formose, vale, vale, inquit, Iolla.
D. Triste lupus stabulis, maturis frugibus imbres,
Arboribus venti, nobis Amaryllidis irae.
M. Dulce satis humor, depulsis arbutus haedis,
Lenta salix feto pecori, mihi solus Amyntas.
D. Pollio amat nostram, quamvis est rustica, Musam:
Pierides, vitulam lectori pascite vestro.
M. Polio et ipse facit nova carmina: pascite taurum,
Iam cornu petat et pedibus qui spargat arenam.
D. Qui te, Pollio, amat, veniat, quo te quoque gaudet;
Mella fluant illi, ferat et rubus asper amomum.
M. Qui Bavium non odit, amet tua carmina, Maevi,
Atque idem iungat vulpes et mulgeat hircos.

D. Qui legitis flores et humi nascentia fraga,
Frigidus, o pueri, fugite hinc, latet anguis in herba,
M. Parcite, oves, nimium procedere: non bene ripae
Creditur; ipse aries etiam nunc vellera siccat.

Ecl., III., 76–95.

1. "Et longum Formose . . . . ," *Longum* may be constructed in two ways.

2. "Pierides, vitulam lectori pascite vestro." Explain what is meant. What is the origin of the name *Pierides?* Give equivalent epithets used in the Eclogues.

3. "Qui te, Pollio, amat, veniat, quo te quoque gaudet." Supply the ellipsis, explain the meaning, and give some account of Polio.

4. "Qui Bavium non odit, amet tua carmina, Maevi." Tell what is known of these persons.

5. "Non bene ripae creditur." Give the rule for the construction.

6. Are there any poetical usages in this extract?

7. Give the dates of Virgil's birth and death. How are his works described in his epitaph? Are any historical events referred to in the Eclogues?

Translate:

Est procul in pelago saxum spumantia contra
Litora, quod tumidis submersum tunditur olim
Fluctibus, hiberni condunt ubi sidera Cori;
Tranquillo silet, immotaque attollitur unda
Campus et aprices statio gratissima mergis.
Hic viridem Aeneas frondenti ex ilice metam
Constituit signum nautis pater, unde reverti
Scirent et longos ubi circumflectere cursus.

Aen., V., 124–131.

IV.—CICERO.

Translate:

Sed cur tam diu de uno hoste loquimur, et de eo hoste, qui iam fatetur se esse hostem, et quem, quia, quod semper volui, murus interest, non timeo: de his, qui dissimulant, qui

Romae remanent, qui nobiscum sunt, nihil dicimus? Quos quidem ego, si ullo modo fieri possit, non tam ulcisci studeo quam sanare sibi ipsos, placare rei publicae; neque id quare fieri non possit, si me audire volent, intelligo. Exponam enim vobis, Quirites, ex quibus generibus hominum istae copiae comparentur; deinde singulis medicinam consilii atque orationis meae, si quam potero, afferam.—*Cat. II.*, 8.

V.—SIGHT READING.

Translate (Caesar, *B. G.*, *VII.*, 63):

Defectione Haeduorum cognita, bellum augetur. Legationes in omnes partes circummittuntur; quantum gratia, auctoritate, pecunia valent, ad sollicitandas civitates nituntur. Nacti obsides, quos Caesar apud eos deposuerat, horum supplicio dubitantes territant. Petunt a Vercingetorige Haedui, ut ad se veniat rationesque belli gerundi communicet. Re impetrata, contendunt ut ipsis summa imperii tradatur; et, re in controversiam deducta, totius Galliae concilium Bibracte indicitur. odem conveniunt undique frequentes.

Translate (Cicero's *Epist.*):

Itineris nostri causa fuit, quod non habebam locum, ubi pro meo iure diutius esse possem, quam fundum Siccae, praesertim nondum rogatione correcta, et simul intellegebam ex eo loco, si te haberem, posse me Brundisium referre, sine te autem non esse nobis illas partis tenendas propter Autronium. Nunc, ut ad te antea scripsi, si ad nos veneris, consilium totius rei capiemus. Iter esse molestum scio, sed tanta calamitas omnis molestias habet. Plura scribere non possum, ita sum animo perculso et abjecto. Cura ut valeas. Data vi. Idus Aprilis Naris Luc.

VI.—COMPOSITION.

Write in Latin:

1. He commands the Ubians to lead away [their] flocks, and convey all their [possessions] from the fields into the towns.

2. He said he would return next day from the country with his daughters, and spend the rest of his life in the city as cheerfully as possible.

3. At Rome; to Rome; from Rome; to the city of Rome.

4. Twice a day; daily; in Winter; in the beginning of Summer.

5. After the manner of beasts; in his usual way.

VII.—HISTORY.

1. What tribes and classes made up the Roman population under Servius Tullius?

2. Describe the causes and effects of the first secession.

3. Describe the origin and events of the first Punic War.

4. Describe the conspiracy of Cataline.

5. Relate the history of the second triumvirate.

IX.—GREEK.

Ἐπεὶ δὲ ἐπὶ τὰς σκηνὰς ἀπῆλθον, οἱ μὲν ἄλλοι περὶ τὰ ἐπιτήδεια ἦσαν, στρατηγοὶ δὲ καὶ λοχαγοὶ συνῆλθον, καὶ ἐνταῦθα πολλὴ ἀπορία ἦν. Ἔνθεν μὲν γὰρ ὄρη ἦν ὑπερύψηλα, ἔνθεν δὲ ὁ ποταμὸς τοσοῦτος τὸ βάθος, ὡς μηδὲ τὰ δόρατα ὑπερέχειν πειρωμένοις τοῦ βάθους. Ἀπορουμένοις δ' αὐτοῖς προσελθών τις ἀνὴρ Ῥόδιος, εἶπεν. Ἐγὼ θέλω, ὦ ἄνδρες, διαβιβάσαι ὑμᾶς κατὰ τετρακισχιλίους ὁπλίτας, ἂν μοι, ὧν δέομαι, ὑπηρετήσητε, καὶ τάλαντον μισθὸν πορίσητε. Ἐρωτώμενος δέ, ὅτου δέοιτο, Ἀσκῶν, ἔφη, δισχιλίων δεήσομαι· πολλὰ δὲ ὁρῶ ταῦτα πρόβατα καὶ αἶγας καὶ βοῦς καὶ ὄνους, ἃ ἀποδαρέντα καί φυσηθέντα ῥᾳδίως ἂν παρέχοι τὴν διάβασιν. Δεήσομαι δὲ καὶ τῶν δεσμῶν, οἷς χρῆσθε περὶ τὰ ὑποζύγια, Τούτοις δ', ἔφη, ζεύξας τοὺς ἀσκοὺς πρὸς ἀλλήλους, ὁρμίσας ἕκαστον ἀσκὸν, λίθους ἀρτήσας καὶ ἀφεὶς ὥσπερ ἀγκύρας εἰς τὸ ὕδωρ, ἐπιβαλῶ ὕλην καὶ γῆν ἐπιφορήσω. Ὅτι μὲν οὐ καταδύσεσθέ, αὐτίκα μάλα εἰσεσθε· πᾶς γαὰρ ἀσκὸς δύο ἄνδρας ἕξει τοῦ μὴ καταδῦναι· ὥστε δὲ μὴ ὀλισθάνειν ἡ ὕλη καὶ ἡ γῆ σχήσει.

Decline: *σκηνάς, ἄλλοι, ἐπιτήδεια, πολλή, ποταμός, βάθος, προσελθών, ὑμᾶς, ὅτου, ταῦτα.*

Compare *πολλή, ἀγαθός, σοφός, σαφής, πρῶτος.*

Give the principal parts of *ἀπῆλθον, ὑπερέχειν, πειρωμένοις, διαβιβάσαι, πορίσητε, δέομαι, ζεύξας.*

Give the following tenses in full: pres. ind. of *ἀπῆλθον*, fut. ind. and pres. opt. of *ἦσαν*, imperf. ind. mid. of *ἀπορουμένοις*, pres. ind. act. of *ἀφείς*.

What cases does *ἐπί* govern? What does *ἔνθεν* mean here, and what is its proper sense? What is the construction of *τὸ βάθος*? What case is *πειρωμένοις*, and why? What is its uncontracted form? What is the construction of *τοῦ βάθους*? Parse *εἶπεν*; why has it the *ν* at the end? What is the construction of *μισθόν*? Where is *πορίσητε* found? Explain its mood. Explain the mood of *δέοιτο*. What case is *ἀσκῶν*, and why is it in that case? Where is *φυσηθέντα* found? How do you recognize its tense? Why the opt. *παρέχοι*? What case is *οἷς*, and why in that case? What is *χρῆσθε* from? What peculiarity in its contraction? Give another verb that is similarly contracted. Where is *ζεύξας* found? Where *ἀφείς*? What tense is *ἐπιβαλῶ*? What serves as pres. for *εἶσεσθε*?

HOMER.

Ἀτρείδη, νῦν γάρ σε, ἄναξ, ἐθέλουσιν Ἀχαιοὶ
πᾶσιν ἐλέγχιστον θέμεναι μερόπεσσι βροτοῖσιν,
οὐδέ τοι ἐκτελέουσιν ὑπόσχεσιν, ἣν περ ὑπέσταν
ἐνθάδ' ἔτι στείχοντες ἀπ' Ἄργεος ἱπποβότοιο,
Ἴλιον ἐκπέρσαντ' ἐυτείχεον ἀπονέεσθαι·
ὣς τε γὰρ ἦ παῖδες νεαροὶ χῆραί τε γυναῖκες
ἀλλήλοισιν ὀδύρονται οἰκόνδε νέεσθαι,
ἦ μὴν καὶ πόνος ἐστὶν ἀνιηθέντα νέεσθαι,
καὶ γὰρ τίς θ' ἕνα μῆνα μένων ἀπὸ ἧς ἀλόχοιο
ἀσχαλάᾳ σὺν νηῒ πολυζύγῳ, ὃν περ ἀέλλαι
χειμέριαι εἰλέωσιν ὀρινομένη τε θάλασσα·
ἡμῖν δ' εἰνατός ἐστι περιτροπέων ἐνιαυτὸς
ἐνθάδε μιμνόντεσσι, τῷ οὐ νεμεσίζομ' Ἀχαιοὺς
ἀσχαλάαν παρὰ νηυσὶ κορωνίσιν· ἀλλὰ καὶ ἔμπης
αἰσχρόν τοι δηρόν τε μένειν κενεόν τε νέεσθαι.

To what class of nouns does *Ἀτρείδη* belong? What peculiarity in its form? Why is *σε* not accented? Parse *ἐλέγχιστον*. What would *θέμεναι* be in Attic? Where is it found?

Why are *μερόπεσσι βροτοῖσιν* dat.? What is the nom. of *μερόπεσσι*? What is peculiar in the form of these two datives? From what is *ὑπέσταν*, and where is it found? Why is *Ἄργεος* uncontracted? Give the Attic form of the ending of *ἱπποβότοιο*. What is *ἐκπέρσαντ'* from? Write it in full; why is the last syllable cut off? What is the force of the ending *δε* in *οἰκόνδε*? In *ἧς ἀλόχοιο*, what part of speech is *ἧς*? Where is *εἰλέωσιν* found? What is the construction of *ἡμῖν*? Give the Attic form of *εἵνατος*; why has its last syllable the accent? In Attic what would *μιμνόντεσσι* become? Give the Attic for *κενεόν*. What is Homer's peculiarity as regards the augment? What in the use of *ὁ* (the article)?

SIGHT READING.

Ὅσα μὲν δὴ ἐν τῇ ἀναβάσει τῇ μετὰ Κύρου ἔπραξαν οἱ Ἕλληνες μέχρι τῆς μάχης, καὶ ὅσα, ἐπεὶ Κῦρος ἐτελεύτησεν, ἐν τῇ πορείᾳ, μέχρις εις τὸν Πόντον ἀφίκοντο, καὶ ὅσα ἐξ τοῦ Πόντου πεζῇ ἐξιόντες καὶ ἐκπλέοντες ἐποίουν, μέχρις ἔξω τοῦ στόματος ἐγένοντο ἐν Χρυσοπόλει τῆς Ἀσίας, ἐν τῷ πρόσθεν λόγῳ δεδήλωται.

Ἐπεὶ δ' ἐδείπνησαν, πρὶν καθεύδειν, παραγγείλαντες ἀκολουθεῖν ἠγοῦντο εὐθὺς ἀφ' ἑσπέρας τὴν διὰ Κρεισιος *(ὁδον), τῷ λαθεῖν πιστεύοντες μᾶλλον ἢ ταῖς σπονδαῖς. Μάλα δὲ χαλεπῶς πορευόμενοι, οἷα δὴ ἐν νυκτί τε καὶ ἐν ὄρεσιν ἀπιόντες καὶ χαλεπὴν ὁδόν, εἰς Αἰγοσθένα ἀφικνοῦνται. ἐνθα δὴ ἀναμείνας, ἕως καὶ οἱ συμμαχοι πάντες παρεγένοντο, ἀπῆγε παν ὁμου το στρατευμα μεχρι Κορινθου· ἐκειθεν δε τους μεν συμμαχους ἀφηκε, τους δε πόλιτας οἰκαδε ἀπηγαγεν.*

Write out this last passage in Greek with the accents, after having translated it.

The examination in history was oral.

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